

# TEST REPORT

for the

## Bluetooth Keyboard

Model # A1016

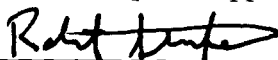
Apple Computer, Inc.

July1, 2003

Engineering contact:

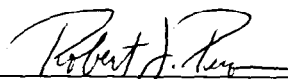
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## Test Report Summary

| Specification from CFR 15 Subpart C | Test Description                                                                                  | Result | Comment     |
|-------------------------------------|---------------------------------------------------------------------------------------------------|--------|-------------|
| CFR 15.203                          | Antenna Requirement                                                                               | Pass   | Section 1.6 |
| CFR 15.209(a)                       | Radiated Emissions<br>30 MHz to 25 GHz                                                            | Pass   | Section 2   |
| CFR 15.247(a)(1)                    | Channel Separation<br>Greater of 25 kHz or 20 dB BW of hopping channel                            | Pass   | Section 3   |
| CFR 15.247(a)(1)(ii)                | Number of Hopping Channels Used<br>Requirement: 75 minimum (equally spaced)                       | Pass   | Section 4   |
| CFR 15.247(a)(1)(ii)                | 20 dB Bandwidth for Frequency Hopping Spread Spectrum<br>Requirement: 1 MHz maximum               | Pass   | Section 5   |
| CFR 15.247(a)(1)(ii)                | Dwell Time on each channel<br>Requirement: 0.4 seconds maximum (within a 30 second period)        | Pass   | Section 6   |
| CFR 15.247(b)(1)                    | Maximum Peak Output Power<br>Requirement: Less than 1 Watt                                        | Pass   | Section 7   |
| CFR 15.247(b)(4)                    | RF Exposure                                                                                       | Pass   | Section 8   |
| CFR 15.247(c)                       | -20 dBc Spurious Emissions                                                                        | Pass   | Section 9   |
| CFR 15.247(f)                       | Power Spectral Density - Hopping Disabled<br>Requirement: Less than +8 dBm in any 3 kHz bandwidth | Pass   | Section 10  |

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## 1 General Information

### 1.1 Introduction and Purpose of test report

This report contains the test results for the Apple Bluetooth keyboard and is intended to demonstrate that the module complies with the FCC Part 15 rules for Frequency Hopping Spread Spectrum transmitters. This report includes data for two different antennas.

### 1.2 Product General and Technical Descriptions

Information on the Apple Bluetooth keyboard is provided in the table below.

| Apple Bluetooth keyboard information |                                   |
|--------------------------------------|-----------------------------------|
| Model Number                         | A1016                             |
| FCC ID                               | BCGA1016                          |
| Class                                | Spread Spectrum Transceiver       |
| Method                               | Frequency Hopping Spread Spectrum |
| Maximum RF Power Output              | 0 dBm                             |
| Frequency Range                      | 2402 MHz - 2480 MHz               |
| Number of Channels                   | 79 equally spaced                 |
| Antenna Type/Antenna Gain            | PCB / 1.08 dBi                    |

*below is the label that appears on the back of the keyboard.*



0984



Complies with the Canadian ICES-003 Class B specifications. Rated 6V DC FCC ID: BCGA1016 IC: 579C-A1016  
EMC No.: 1937 TM and © 2003 Apple Computer, Inc. All rights reserved. アップルコンピュータ株式会社

*below is the label that appears inside the battery well*

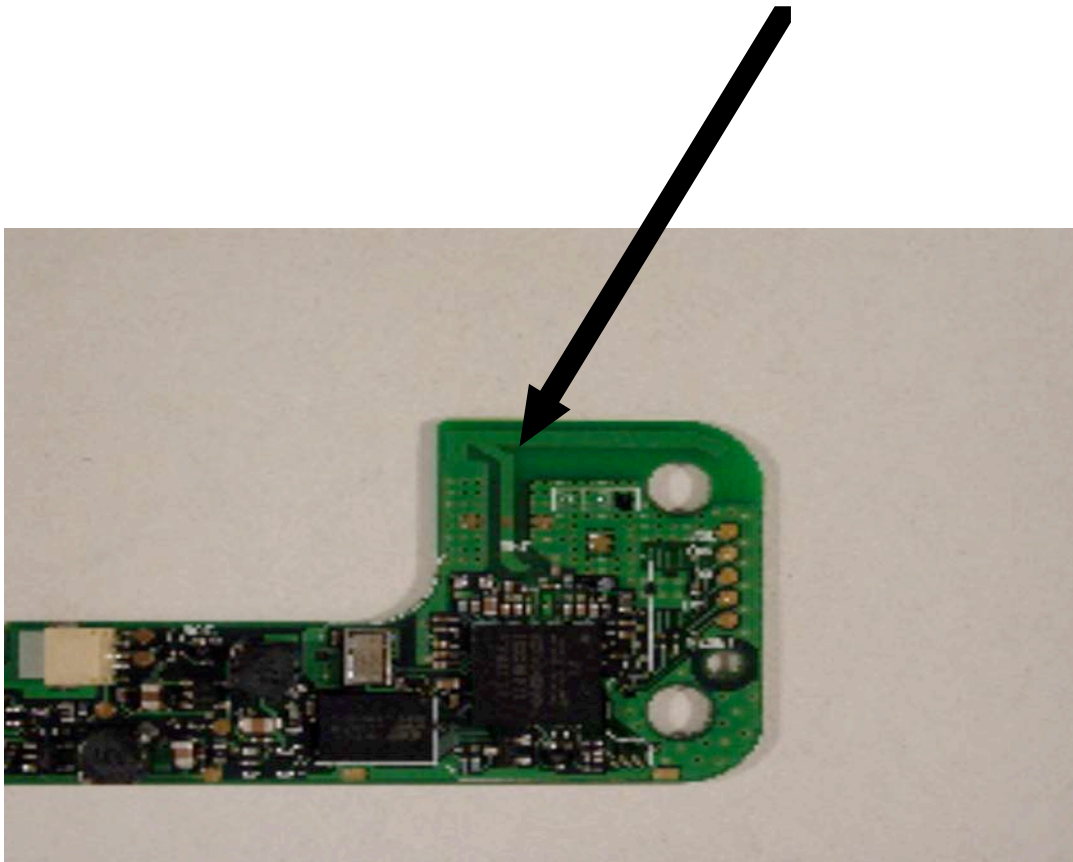
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: 1) This device may not cause harmful interference and 2) this device must accept interference received, including interference which may cause harmful interference.

**1.6 Antenna Information****1.6.1 CFR 47 Section 15.203(a) Antenna Requirement**

Per CFR 47 Section 15.203(a), an intentional radiator shall be designed to insure that no antenna other than that furnished by the responsible party shall be used with the device.

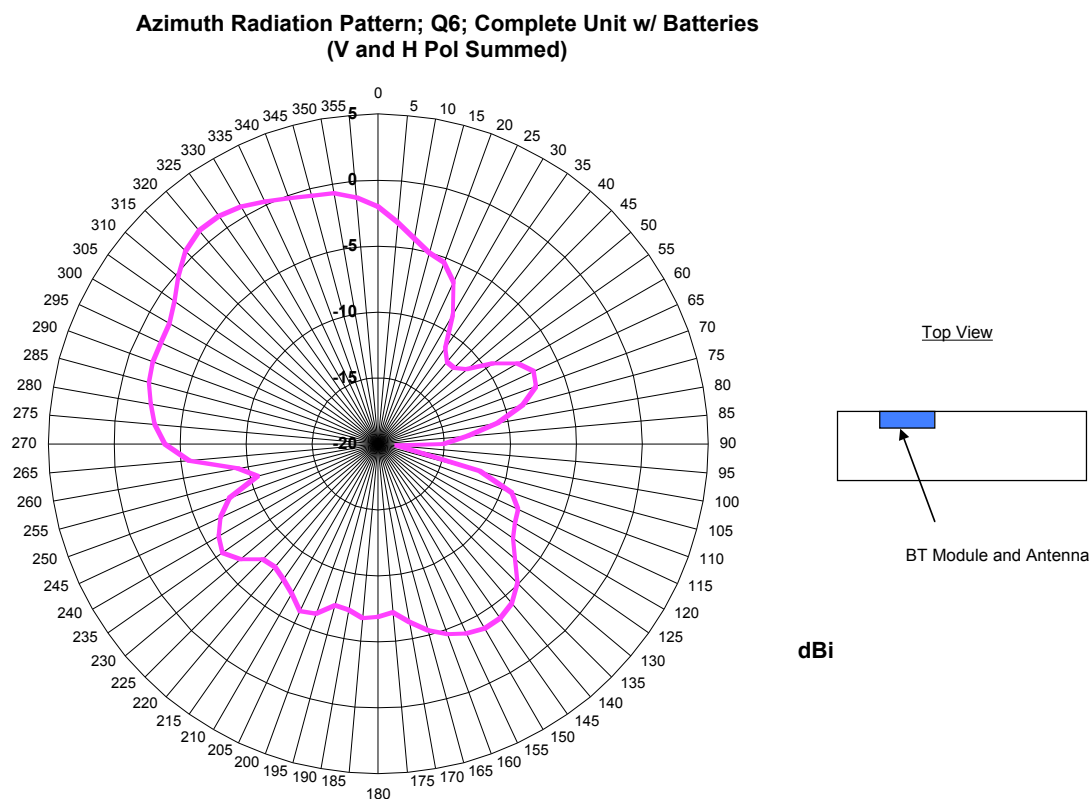
**1.6.2 Antenna Photograph**

The Apple Bluetooth Keyboard uses a printed antenna on the PCB. Below is a picture.



### 1.6.3 Antenna Electrical Information

#### Radiation Pattern



## Tabular Data of Antenna Radiation Patterns

| Degree | Gain (dBi) |  | Degree | Gain (dBi) |
|--------|------------|--|--------|------------|
| 0      | -2.00      |  | 180    | -6.90      |
| 5      | -3.13      |  | 185    | -6.75      |
| 10     | -4.23      |  | 190    | -7.23      |
| 15     | -5.00      |  | 195    | -7.32      |
| 20     | -5.40      |  | 200    | -6.30      |
| 25     | -6.46      |  | 205    | -6.03      |
| 30     | -8.71      |  | 210    | -6.92      |
| 35     | -11.14     |  | 215    | -7.49      |
| 40     | -11.89     |  | 220    | -7.83      |
| 45     | -11.82     |  | 225    | -7.66      |
| 50     | -11.23     |  | 230    | -6.36      |
| 55     | -9.37      |  | 235    | -5.62      |
| 60     | -7.82      |  | 240    | -6.05      |
| 65     | -7.03      |  | 245    | -6.83      |
| 70     | -7.28      |  | 250    | -8.04      |
| 75     | -8.65      |  | 255    | -10.55     |
| 80     | -10.80     |  | 260    | -9.21      |
| 85     | -13.15     |  | 265    | -5.63      |
| 90     | -15.08     |  | 270    | -3.85      |
| 95     | -18.61     |  | 275    | -2.99      |
| 100    | -17.65     |  | 280    | -2.51      |
| 105    | -12.07     |  | 285    | -2.05      |
| 110    | -9.23      |  | 290    | -1.83      |
| 115    | -8.28      |  | 295    | -1.85      |
| 120    | -8.01      |  | 300    | -1.74      |
| 125    | -7.49      |  | 305    | -1.16      |
| 130    | -6.44      |  | 310    | -0.22      |
| 135    | -5.11      |  | 315    | 0.65       |
| 140    | -4.22      |  | 320    | 1.08       |
| 145    | -3.86      |  | 325    | 1.08       |
| 150    | -3.86      |  | 330    | 0.78       |
| 155    | -4.16      |  | 335    | 0.27       |
| 160    | -4.63      |  | 340    | -0.20      |
| 165    | -5.37      |  | 345    | -0.55      |
| 170    | -6.32      |  | 350    | -0.70      |
| 175    | -7.20      |  | 355    | -1.29      |

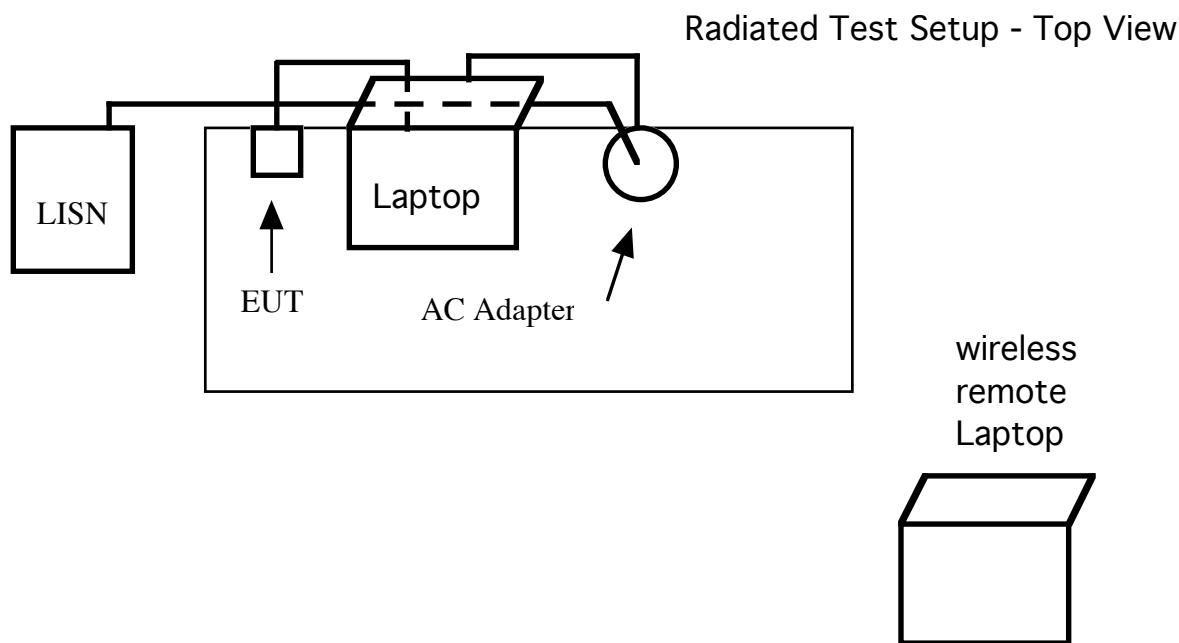
## 2 CFR 15.209(a) Radiated Emissions

### 2.1 CFR 15.209(a) Radiated Emissions less than 1 GHz

Pre-scans below 1 GHz were performed with the transmitter frequency set to the low, mid and high channels. In each case, the emissions below 1 GHz were found to be similar. Thus radiated emissions data in this report below 1 GHz is provided for channel 1 only.

#### 2.1.1 CFR 15.209(a) Radiated Emissions less than 1 GHz Test Setup

Radiated Emission measurements at or below 1 GHz were performed at the Apple Computer Test Site ALTS #1, located at 123 East Evelyn Ave., Mountain View, California. The EUT was placed on a nonmetallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered ac mains supply.



### 2.1.2 CFR 15.209(a) Radiated Emissions less than 1 GHz Test Procedure

The frequency spectrum from 30 MHz to  $\leq 1$  GHz was scanned and the emission levels maximized at each frequency recorded. The antenna was varied in height between 1.0 and 4.0 meters and the system was rotated 360 degrees while scanning for maximum emission amplitudes. This procedure was performed for both horizontal and vertical polarization of the receiving antenna. During maximization the position of the cables was varied and the scanning repeated until the worst case emission was found. The data recorded in this report are the maximum emission levels measured.

Radiated Emission measurements at or below 1 GHz were performed at an EUT to antenna distance of 3 meters.

### 2.1.3 CFR 15.209(a) Radiated Emissions less than 1 GHz Test Equipment

The following test equipment was used when performing radiated emissions tests below 1 GHz.

| Description       | Manufacturer    | Model No. | Identification No. | Last Cal | Next Cal |
|-------------------|-----------------|-----------|--------------------|----------|----------|
| Spectrum Analyzer | Hewlett Packard | 8566      | E4663/E            | 7/02     | 7/03     |
| EMI Receiver      | R&S             | ESI 26    | 100025             | 8/02     | 8/03     |
| Amplifier         | HP              | 8449B     | 3008A00713         | 3/03     | 3/04     |
| Coaxial Cable     | Huber & Suhner  | SF106     | 0.29               | 4/03     | 4/04     |
| Antenna           | Horn Antenna    | 3115      | 9205-3852          | 9/00     | 9/03     |

Notes: HP is an abbreviation for Hewlett Packard.  
R&S is an abbreviation for Rhode & Schwarz.  
N/A is an abbreviation for Not Applicable  
The above equipment is traceable to NVLAP calibration standards.

#### 3.1.3.1 CFR 15.209(a) Radiated Emissions less than 1 GHz Instrument Settings:

| Instrument Settings |                 |             |               |          |
|---------------------|-----------------|-------------|---------------|----------|
| Frequency Range     | Reference Level | Attenuation | Resolution BW | Video BW |
| 30 MHz - 1 GHz      | 90 dBuV         | 10          | 100 kHz       | 100 kHz  |

### 2.1.4 CFR 15.209(a) Radiated Emissions less than 1 GHz EUT Operation Conditions

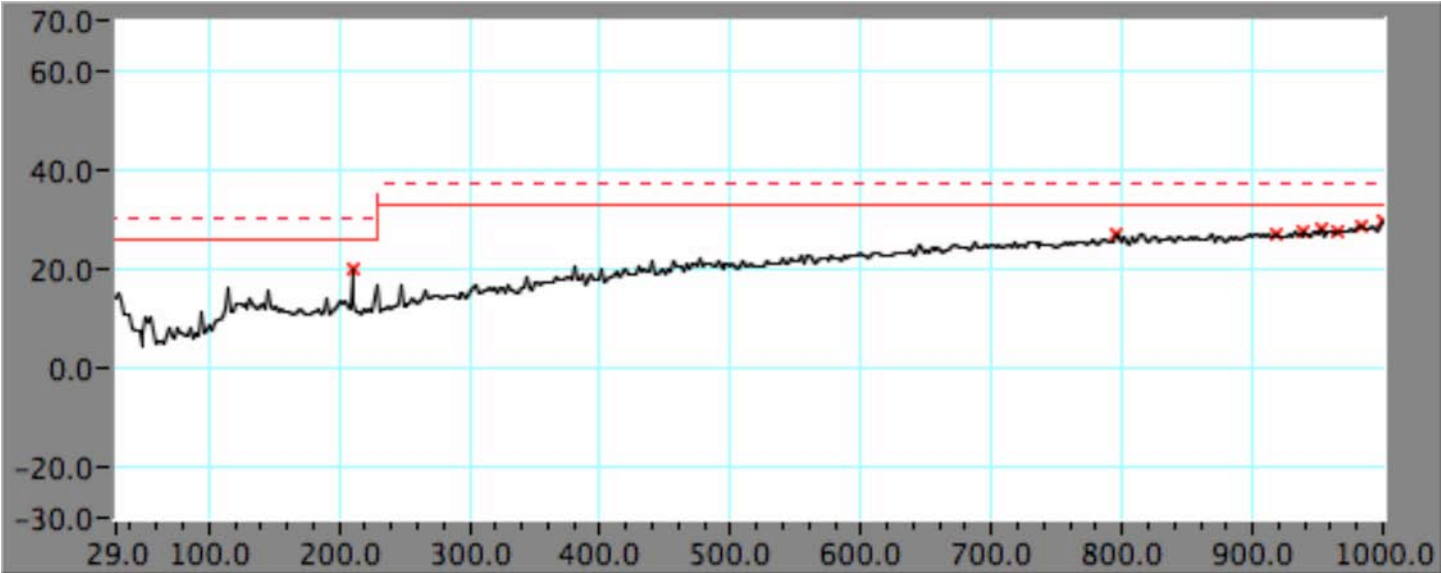
The Bluetooth keyboard was activated using special test software which sets the transmitter to continuously transmit at a single frequency. The transmitter was set to the lowest, mid and highest channels. In each case the scans were performed.

- low (channel 1) - 2.402 GHz
- mid (channel 40) - 2.441 GHz
- high (channel 79) - 2.480 GHz

Data below 1 GHz looked similar regardless of whether the transmitter was set to the low, mid or highest channel. In this report, data is provided for the lowest channel only.

2.1.5 CFR 15.209(a) Radiated Emissions less than 1 GHz - Vertical Data

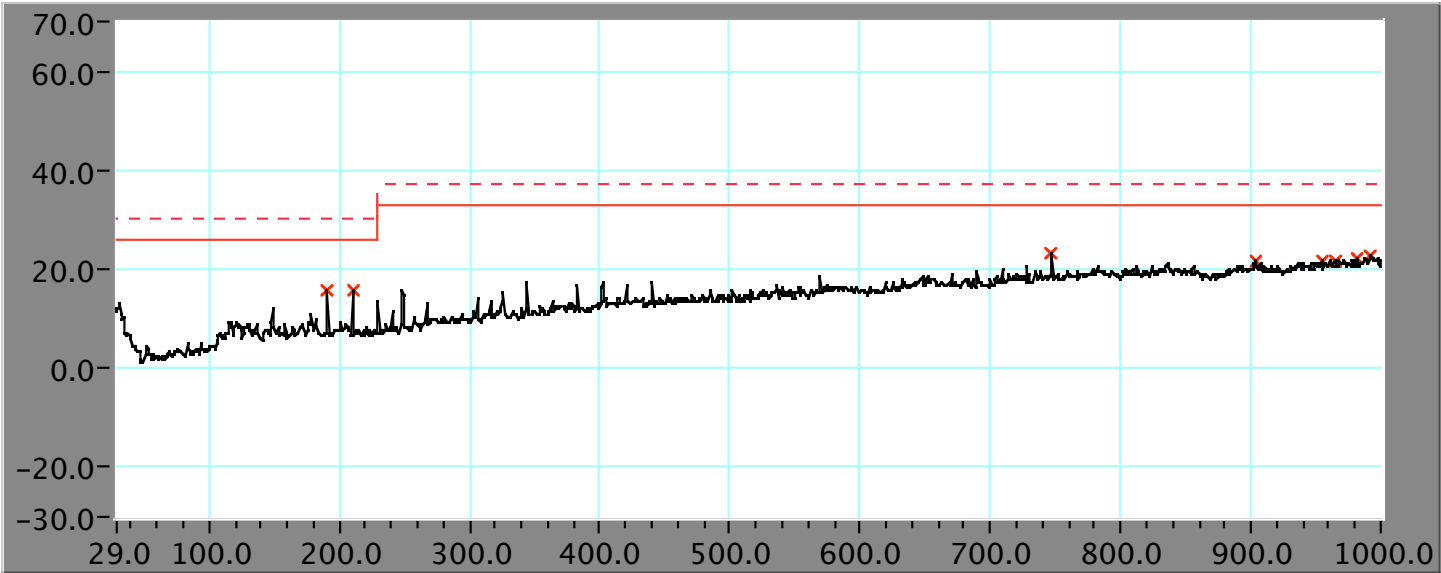
The data below was collected with a transmitter frequency of 2.402 GHz which is the lowest channel.



| Frequency | Level  | Limit  | Delta | Raw Data | Antenna | Cable | Amp   | All Factor |
|-----------|--------|--------|-------|----------|---------|-------|-------|------------|
| MHz       | dBuV/m | dBuV/m | dB    | dBuV     | dB      | dB    | dB    | dB         |
| 209.97    | 19.9   | 26.0   | -6.1  | 56.03    | 11.21   | 2.51  | 49.79 | 36.08      |
| 795.68    | 26.9   | 33.0   | -6.1  | 48.21    | 21.69   | 5.64  | 48.61 | 21.29      |
| 918.27    | 27.2   | 33.0   | -5.8  | 47.00    | 22.54   | 6.24  | 48.55 | 19.77      |
| 939.68    | 27.7   | 33.0   | -5.3  | 47.46    | 22.29   | 6.32  | 48.39 | 19.78      |
| 953.30    | 27.9   | 33.0   | -5.1  | 46.60    | 23.10   | 6.45  | 48.29 | 18.74      |
| 964.97    | 27.4   | 33.0   | -5.6  | 45.65    | 23.50   | 6.50  | 48.21 | 18.20      |
| 984.43    | 28.7   | 33.0   | -4.3  | 46.06    | 23.89   | 6.61  | 47.81 | 17.31      |
| 1000.00   | 29.7   | 33.0   | -3.3  | 46.09    | 24.40   | 6.67  | 47.46 | 16.38      |
|           |        |        |       |          |         |       |       |            |
|           |        |        |       |          |         |       |       |            |
|           |        |        |       |          |         |       |       |            |
|           |        |        |       |          |         |       |       |            |

2.1.6 CFR 15.209(a) Radiated Emissions less than 1 GHz - Horizontal Data

The data below was collected with a transmitter frequency of 2.402 GHz.



| Frequency<br>MHz | Level<br>dBuV/m | Limit<br>dBuV/m | Delta<br>dB | Raw Data<br>dBuV | Cable<br>dB | Amp<br>dB | All Factors<br>dB |
|------------------|-----------------|-----------------|-------------|------------------|-------------|-----------|-------------------|
| 191.16           | 15.7            | 26.0            | -10.3       | 54.20            | 2.72        | 52.74     | 38.50             |
| 210.58           | 15.9            | 26.0            | -10.1       | 55.21            | 2.86        | 52.88     | 39.31             |
| 747.54           | 23.0            | 33.0            | -10.0       | 49.53            | 5.52        | 52.61     | 26.53             |
| 903.87           | 21.7            | 33.0            | -11.3       | 46.76            | 6.15        | 52.79     | 25.06             |
| 954.36           | 21.6            | 33.0            | -11.4       | 45.16            | 6.41        | 52.53     | 23.56             |
| 965.04           | 21.4            | 33.0            | -11.6       | 44.81            | 6.46        | 52.47     | 23.41             |
| 981.55           | 22.2            | 33.0            | -10.8       | 44.71            | 6.49        | 52.23     | 22.51             |
| 992.23           | 22.5            | 33.0            | -10.5       | 44.34            | 6.57        | 51.97     | 21.84             |
|                  |                 |                 |             |                  |             |           |                   |
|                  |                 |                 |             |                  |             |           |                   |
|                  |                 |                 |             |                  |             |           |                   |
|                  |                 |                 |             |                  |             |           |                   |

All levels are with a peak detector.

**2.2 CFR 15.209(a) Radiated Emissions greater than 1 GHz****2.2.1 CFR 15.209(a) Radiated Emissions greater than 1 GHz Test Setup**

Radiated Emission measurements above 1 GHz were performed at the Apple Computer 3 meter semi-anechoic chamber located at 20650 Valley Green Drive. The EUT was placed on a nonmetallic table, 80 cm above the metallic ground-plane. The EUT and peripherals were powered from a filtered main supply.

Radiated Emission measurements above 1 GHz were performed at an EUT to antenna distance of 1 meter.

**2.2.2 CFR 15.209(a) Radiated Emissions greater than 1 GHz Test Procedure**

The frequency spectrum from 1 GHz to 25 GHz was scanned and the emission levels maximized at each frequency. The antenna was varied in height and the system was rotated 360 degrees while scanning for maximum emission amplitudes. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

Scans above 1 GHz were performed with the transmitter frequency set to the low, mid and high channels and Radiated Emissions data is provided in this report for each case.

- low (channel 1) - 2.402 GHz
- mid (channel 40) - 2.441 GHz
- high (channel 79) - 2.480 GHz

**2.2.3 CFR 15.209(a) Radiated Emissions greater than 1 GHz Test Equipment**

The following test equipment was used when performing radiated emissions tests above 1 GHz.

| Description       | Model                 | Serial Number | Last Calibration | Next Calibration |
|-------------------|-----------------------|---------------|------------------|------------------|
| Spectrum Analyzer | R&S ESIB 26           | 100025        | 8/03             | 8/04             |
| Receiver          | R&S ESIB 26           | 100025        | 8/03             | 8/04             |
| Spectrum Analyzer | HP 8566               | E4662_E4663   | 5/02             | 5/03             |
| Antenna           | Horn Antenna 3115     | 9205-3852     | 9/00             | 9/03             |
| Cable             | Huber & Schuner SF106 | 0.29          | 4/03             | 4/04             |

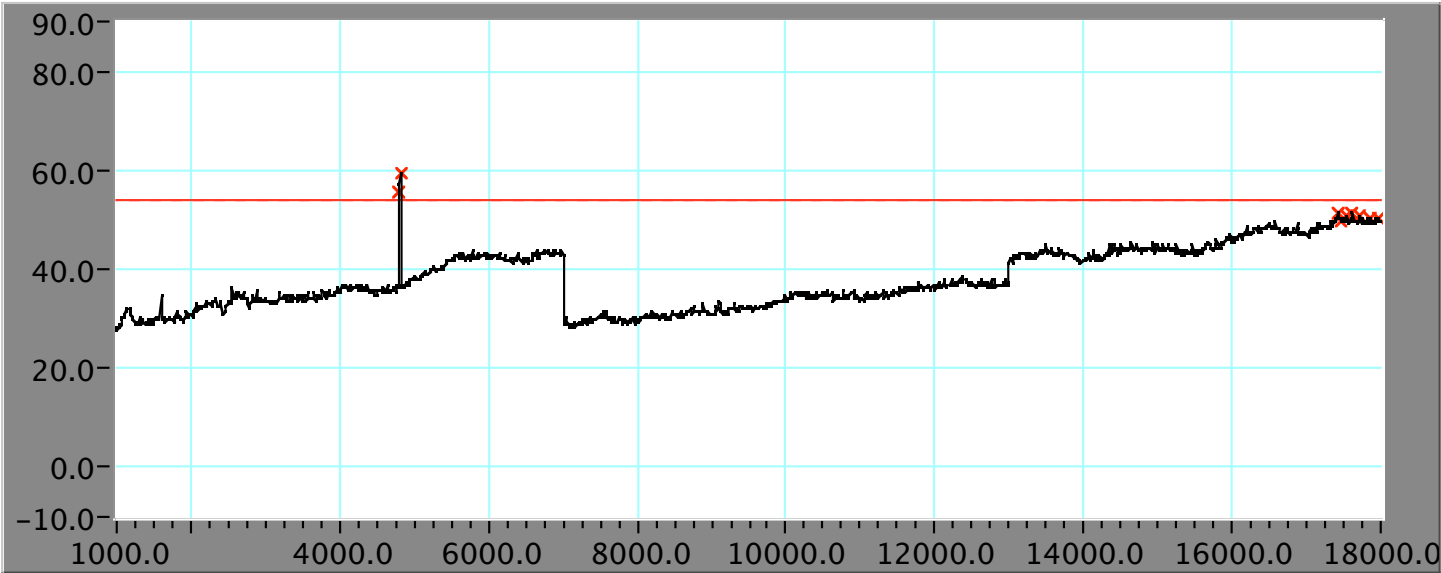
**2.2.3.1 CFR 15.209(a) Radiated Emissions greater than 1 GHz Instrument Settings**

| Instrument Settings |                 |             |               |          |
|---------------------|-----------------|-------------|---------------|----------|
| Frequency Range     | Reference Level | Attenuation | Resolution BW | Video BW |
| 1 GHz - 7 GHz       | 110 dBuV        | 20          | 1 MHz         | 1 MHz    |
| 7 GHz - 13 GHz      | 120 dBuV        | 30          | 1 MHz         | 1 MHz    |
| 13 GHz - 18 GHz     | 100 dBuV        | 10          | 1 MHz         | 1 MHz    |
| 18 GHz - 25 GHz     | 100 dBuV        | 0           | 1 MHz         | 1 MHz    |

**2.2.4 CFR 15.209(a) Radiated Emissions greater than 1 GHz EUT Operating Conditions**

The Bluetooth keyboard keyboard was set to continuously transmit on low, mid, and high channels using special test software.

2.2.5 CFR 15.209(a) Radiated Emissions - Vertical, channel 1 (2.402 GHz)



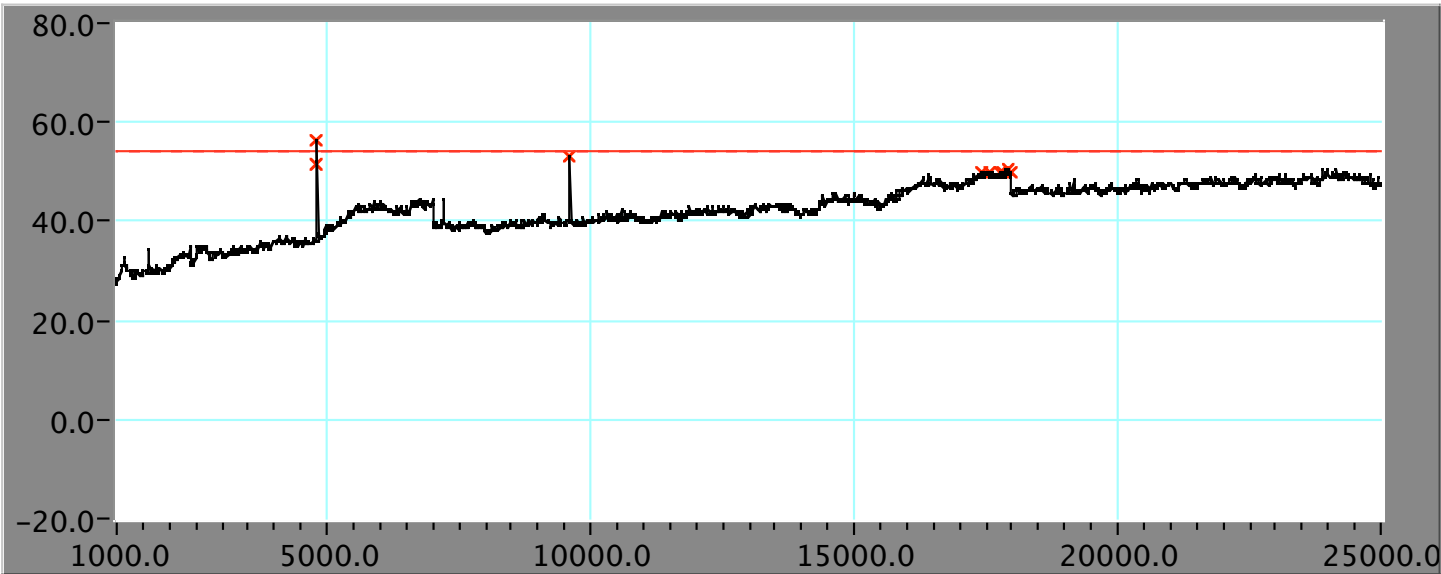
| Frequency | Level   | Limit  | Delta | Raw Data | All Factors |
|-----------|---------|--------|-------|----------|-------------|
| MHz       | dBuV/m  | dBuV/m | dB    | dBuV     | dB          |
| 17478.96  | 49.9    | 54.0   | -4.1  | 42.10    | -7.83       |
| 17849.70  | 50.2    | 54.0   | -3.8  | 42.40    | -7.82       |
| 17959.92  | 50.2    | 54.0   | -3.8  | 42.44    | -7.78       |
| 17539.08  | 51.0    | 54.0   | -3.0  | 43.04    | -7.91       |
| 17709.42  | 51.0    | 54.0   | -3.0  | 43.16    | -7.86       |
| 17418.84  | 51.2    | 54.0   | -2.8  | 43.61    | -7.55       |
| 17619.24  | 51.4    | 54.0   | -2.6  | 43.50    | -7.88       |
| 4803.68   | 55.8 Av | 54.0   | 1.8   | 69.57    | 13.74       |
| 4811.62   | 59.5    | 54.0   | 5.5   | 73.13    | 13.65       |
|           |         |        |       |          |             |
|           |         |        |       |          |             |
|           |         |        |       |          |             |

All levels are with a peak detector unless otherwise indicated.

\*\*\*NOTE:

The frequency line at 4.803GHz appears to produce a failure. However, in applying the duty cycle compensation factor, a -32.4dB reduction is realized. (See page 42)

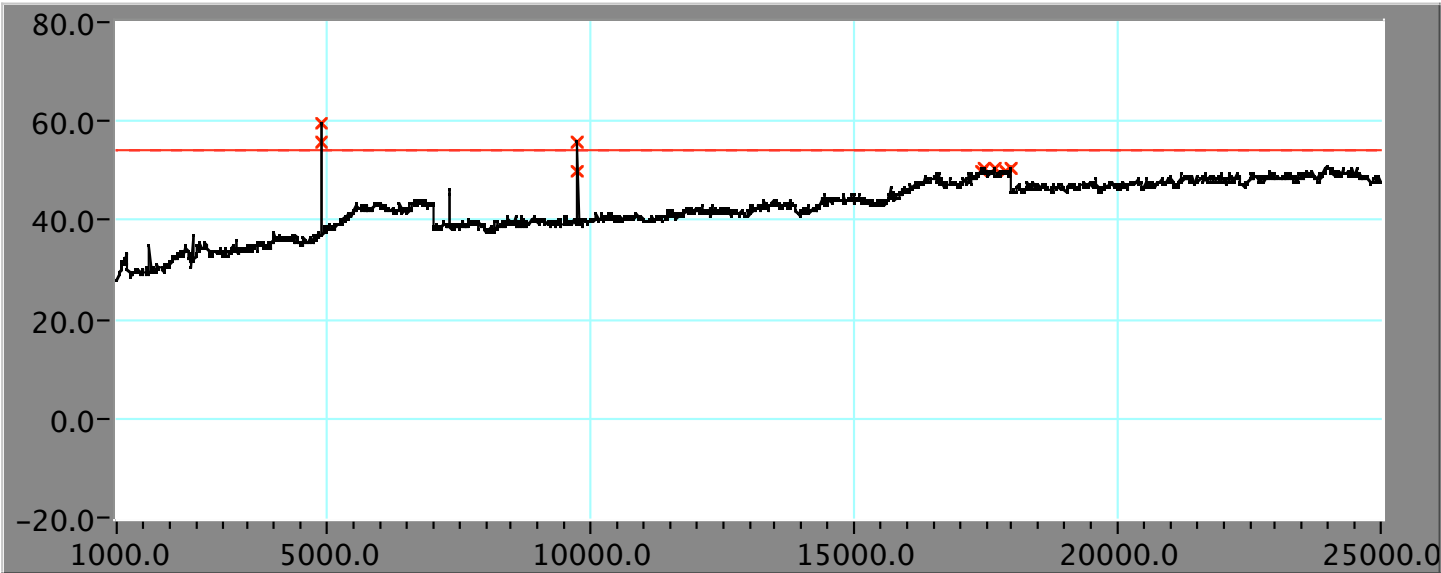
2.2.6 CFR 15.209(a) Radiated Emissions - Horizontal, channel 1 (2.402 GHz)



| Frequency | Level   | Limit  | Delta | Raw Data | All Factors |
|-----------|---------|--------|-------|----------|-------------|
| MHz       | dBuV/m  | dBuV/m | dB    | dBuV     | dB          |
| 17759.52  | 49.7    | 54.0   | -4.3  | 42.01    | -7.65       |
| 17839.68  | 49.8    | 54.0   | -4.2  | 42.15    | -7.69       |
| 17408.82  | 49.9    | 54.0   | -4.1  | 42.74    | -7.15       |
| 17989.98  | 50.1    | 54.0   | -3.9  | 42.32    | -7.76       |
| 17589.18  | 50.2    | 54.0   | -3.8  | 42.59    | -7.56       |
| 17919.84  | 50.3    | 54.0   | -3.7  | 42.58    | -7.73       |
| 4803.68   | 51.3 Av | 54.0   | -2.7  | 65.04    | 13.74       |
| 9609.22   | 52.9    | 54.0   | -1.1  | 57.89    | 4.99        |
| 4811.62   | 56.2    | 54.0   | 2.2   | 69.89    | 13.65       |
|           |         |        |       |          |             |
|           |         |        |       |          |             |
|           |         |        |       |          |             |

All levels are with a peak detector unless otherwise indicated.

2.2.7 CFR 15.209(a) Radiated Emissions - Vertical channel 40 (2.441 GHz)



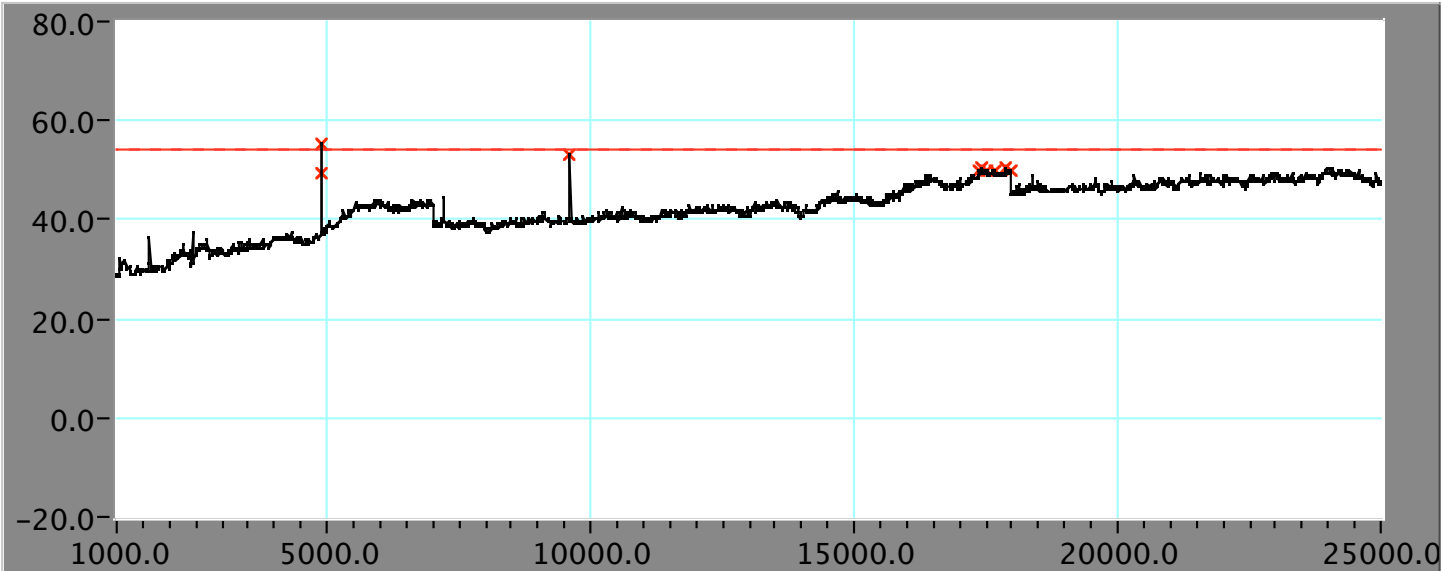
| Frequency | Level   | Limit  | Delta | Raw Data | All Factors |
|-----------|---------|--------|-------|----------|-------------|
| MHz       | dBuV/m  | dBuV/m | dB    | dBuV     | dB          |
| 4881.63   | 55.8 Av | 54.0   | 1.8   | 68.93    | 13.12       |
| 4883.77   | 59.5    | 54.0   | 5.5   | 72.59    | 13.12       |
| 9764.62   | 49.8 Av | 54.0   | -4.2  | 54.43    | 4.60        |
| 9765.53   | 56.0    | 54.0   | 2.0   | 60.56    | 4.60        |
| 17408.82  | 49.7    | 54.0   | -4.3  | 42.22    | -7.51       |
| 17478.96  | 50.4    | 54.0   | -3.6  | 42.55    | -7.83       |
| 17669.34  | 50.3    | 54.0   | -3.7  | 42.44    | -7.87       |
| 17859.72  | 49.9    | 54.0   | -4.1  | 42.13    | -7.81       |
| 17959.92  | 50.2    | 54.0   | -3.8  | 42.41    | -7.78       |
|           |         |        |       |          |             |
|           |         |        |       |          |             |
|           |         |        |       |          |             |

All levels are with a peak detector unless otherwise indicated.

\*\*\*NOTE:

The frequency line at 4.803GHz appears to produce a failure. However, in applying the duty cycle compensation factor, a -31.1dB reduction is realized. (See page 42)

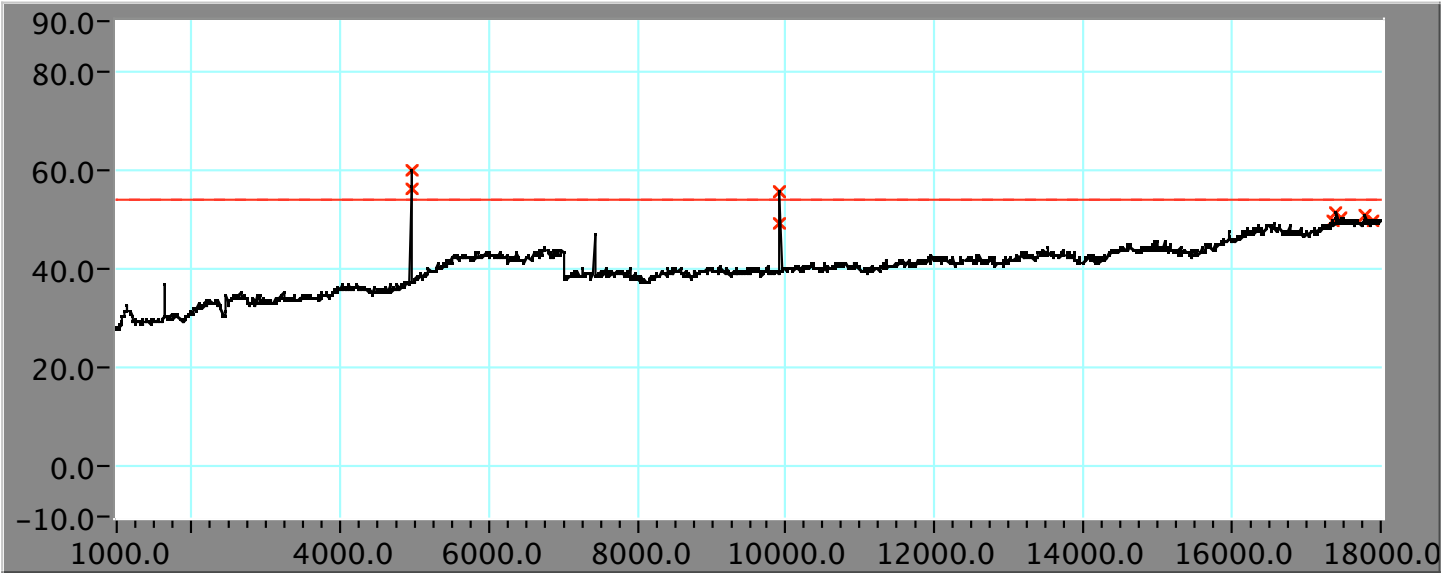
2.2.8 CFR 15.209(a) Radiated Emissions - Horizontal channel 40 (2.441 GHz)



| Frequency | Level   | Limit  | Delta | Raw Data | All Factors |
|-----------|---------|--------|-------|----------|-------------|
| MHz       | dBuV/m  | dBuV/m | dB    | dBuV     | dB          |
| 4882.27   | 49.4 Av | 54.0   | -4.6  | 62.51    | 13.12       |
| 4883.77   | 55.2    | 54.0   | 1.2   | 68.35    | 13.12       |
| 9609.22   | 52.9    | 54.0   | -1.1  | 57.89    | 4.99        |
| 17378.76  | 49.8    | 54.0   | -4.2  | 42.82    | -7.02       |
| 17438.88  | 50.3    | 54.0   | -3.7  | 43.01    | -7.27       |
| 17519.04  | 50.1    | 54.0   | -3.9  | 42.52    | -7.53       |
| 17679.36  | 49.8    | 54.0   | -4.2  | 42.19    | -7.61       |
| 17889.78  | 50.5    | 54.0   | -3.5  | 42.81    | -7.71       |
| 18000.00  | 49.9    | 54.0   | -4.1  | 42.08    | -7.77       |
|           |         |        |       |          |             |
|           |         |        |       |          |             |
|           |         |        |       |          |             |

All levels are with a peak detector unless otherwise indicated.

2.2.9 CFR 15.209(a) Radiated Emissions - Vertical Channel 79 (2.480 GHz)



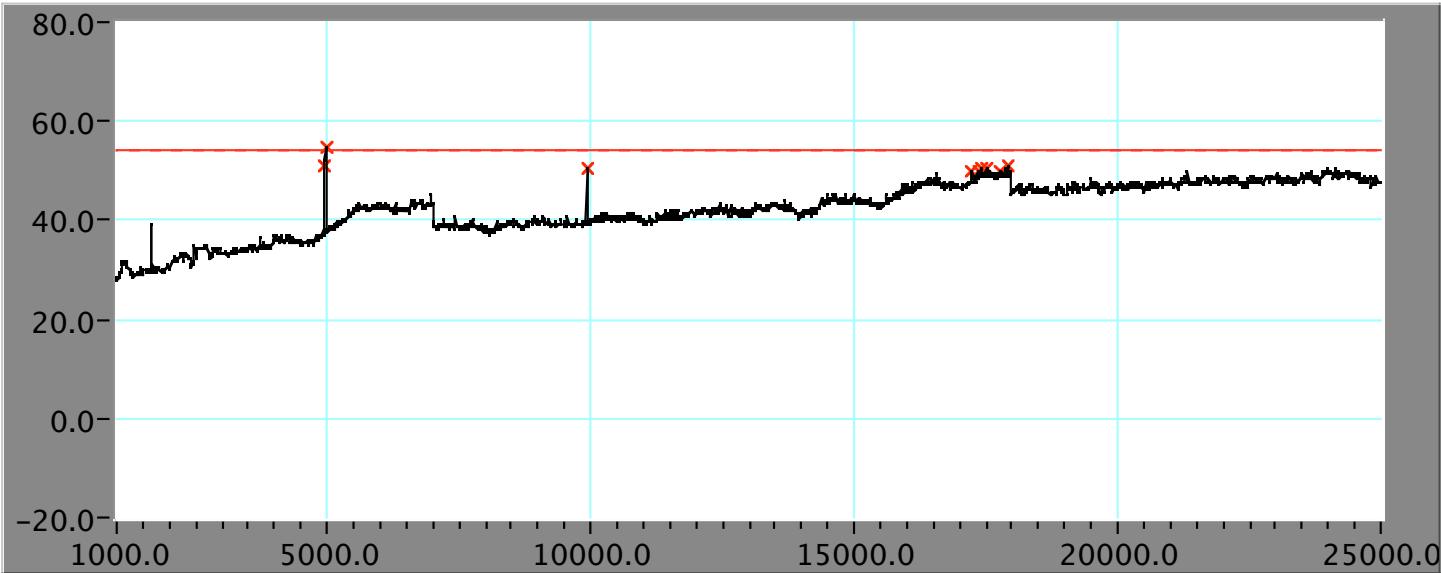
| Frequency | Level   | Limit  | Delta | Raw Data | All Factors |
|-----------|---------|--------|-------|----------|-------------|
| MHz       | dBuV/m  | dBuV/m | dB    | dBuV     | dB          |
| 4960.02   | 56.2 Av | 54.0   | 2.2   | 68.77    | 12.59       |
| 4967.94   | 59.9    | 54.0   | 5.9   | 72.40    | 12.50       |
| 9920.46   | 49.2 Av | 54.0   | -4.8  | 53.38    | 4.20        |
| 9921.84   | 55.7    | 54.0   | 1.7   | 59.88    | 4.20        |
| 17348.70  | 49.9    | 54.0   | -4.1  | 42.62    | -7.24       |
| 17408.82  | 51.1    | 54.0   | -2.9  | 43.61    | -7.51       |
| 17468.94  | 50.2    | 54.0   | -3.8  | 42.42    | -7.78       |
| 17799.60  | 50.8    | 54.0   | -3.2  | 43.01    | -7.83       |
| 17899.80  | 49.8    | 54.0   | -4.2  | 42.01    | -7.80       |
|           |         |        |       |          |             |
|           |         |        |       |          |             |
|           |         |        |       |          |             |

All levels are with a peak detector unless otherwise indicated.

\*\*\*NOTE:

The frequency line at 4.803GHz appears to produce a failure. However, in applying the duty cycle compensation factor, a -31.1dB reduction is realized. (See page 42)

2.2.10 CFR 15.209(a) Radiated Emissions - Horizontal Channel 79 (2.480 GHz)



| Frequency | Level   | Limit  | Delta | Raw Data | All Factors |
|-----------|---------|--------|-------|----------|-------------|
| MHz       | dBuV/m  | dBuV/m | dB    | dBuV     | dB          |
| 17238.48  | 49.7    | 54.0   | -4.3  | 43.30    | -6.45       |
| 17348.70  | 49.8    | 54.0   | -4.2  | 42.94    | -6.90       |
| 17799.60  | 49.9    | 54.0   | -4.1  | 42.20    | -7.67       |
| 17418.84  | 50.4    | 54.0   | -3.6  | 43.18    | -7.19       |
| 17499.00  | 50.6    | 54.0   | -3.4  | 43.06    | -7.52       |
| 9921.84   | 50.6    | 54.0   | -3.4  | 54.78    | 4.20        |
| 17919.84  | 50.7    | 54.0   | -3.3  | 42.97    | -7.73       |
| 4960.22   | 50.8 Av | 54.0   | -3.2  | 63.41    | 12.59       |
| 4967.94   | 54.6    | 54.0   | 0.6   | 67.07    | 12.50       |
|           |         |        |       |          |             |
|           |         |        |       |          |             |
|           |         |        |       |          |             |

All levels are with a peak detector unless otherwise indicated.

### 2.3 CFR 15.247(c) Band Edge Tests

The emissions at the band edges must be -20 dB below the highest emission of the operating band within a 100 kHz bandwidth.

#### 2.3.1 CFR 15.247(c) Band Edge Test Description

Band Edge measurements were performed at the Apple Computer EMC lab located in Mountain View. The EUT was placed on a nonmetallic table. The EUT and peripherals were powered from a filtered main supply. Using special test software, the Apple Bluetooth keyboard was placed into continuous modulated transmit on the high and low channels. Peak and average scans were obtained at the band edges.

#### 2.3.2 CFR 15.247(c) Band Edge Test Equipment

The following test equipment was used when performing band edge measurements.

| Description       | Model                 | Serial Number | Last Calibration | Next Calibration |
|-------------------|-----------------------|---------------|------------------|------------------|
| Spectrum Analyzer | R&S ESIB 26           | 100025        | 8/03             | 8/04             |
| Receiver          | R&S ESIB 26           | 100025        | 8/03             | 8/04             |
| Spectrum Analyzer | HP 8566               | E4662_E4663   | 5/02             | 5/03             |
| Antenna           | Horn Antenna 3115     | 9205-3852     | 9/00             | 9/03             |
| Cable             | Huber & Schuner SF106 | 0.29          | 4/03             | 4/04             |

#### 2.3.3 CFR 15.247(c) Band Edge - Hopping Enabled Instrument Settings

##### *Peak Measurements*

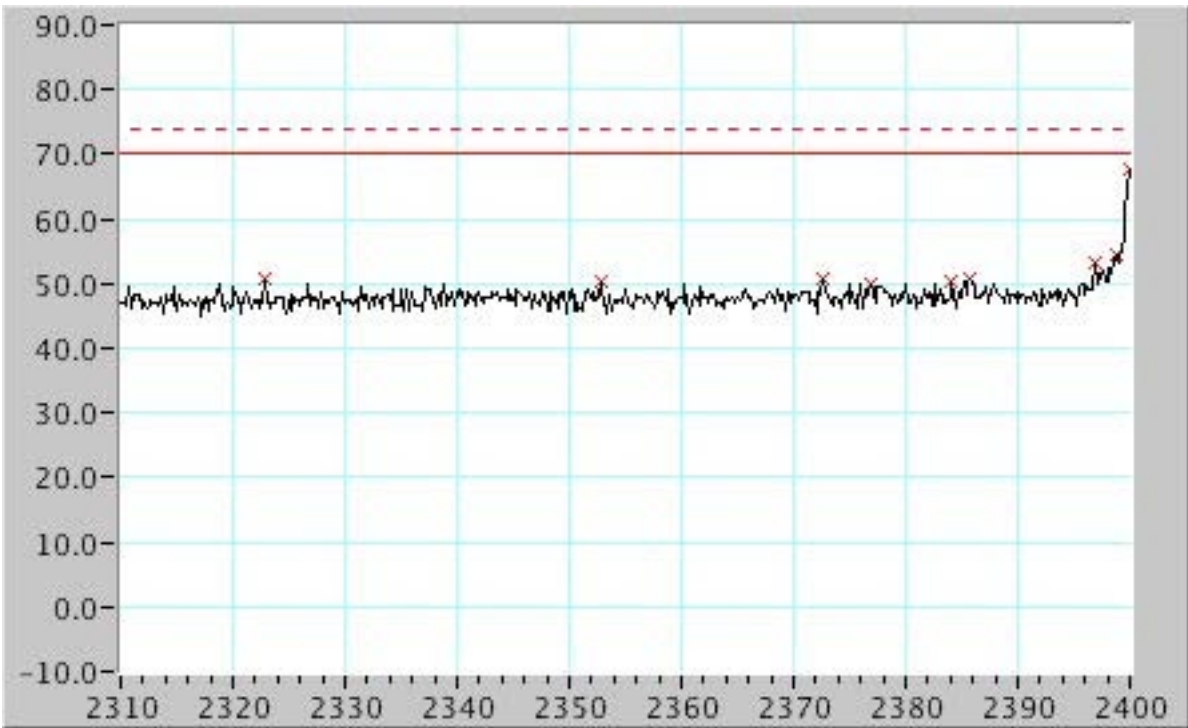
| Instrument Settings |             |               |          |             |        |
|---------------------|-------------|---------------|----------|-------------|--------|
| Reference Level     | Attenuation | Resolution BW | Video BW | Sweep Rate  | Span   |
| 10 dBm              | 40 dB       | 1000 kHz      | 1000 kHz | 200 Seconds | 12 MHz |

##### *Average Measurements*

| Instrument Settings |             |               |          |             |        |
|---------------------|-------------|---------------|----------|-------------|--------|
| Reference Level     | Attenuation | Resolution BW | Video BW | Sweep Rate  | Span   |
| 10 dBm              | 40 dB       | 1000 kHz      | 0.01 kHz | 200 Seconds | 12 MHz |

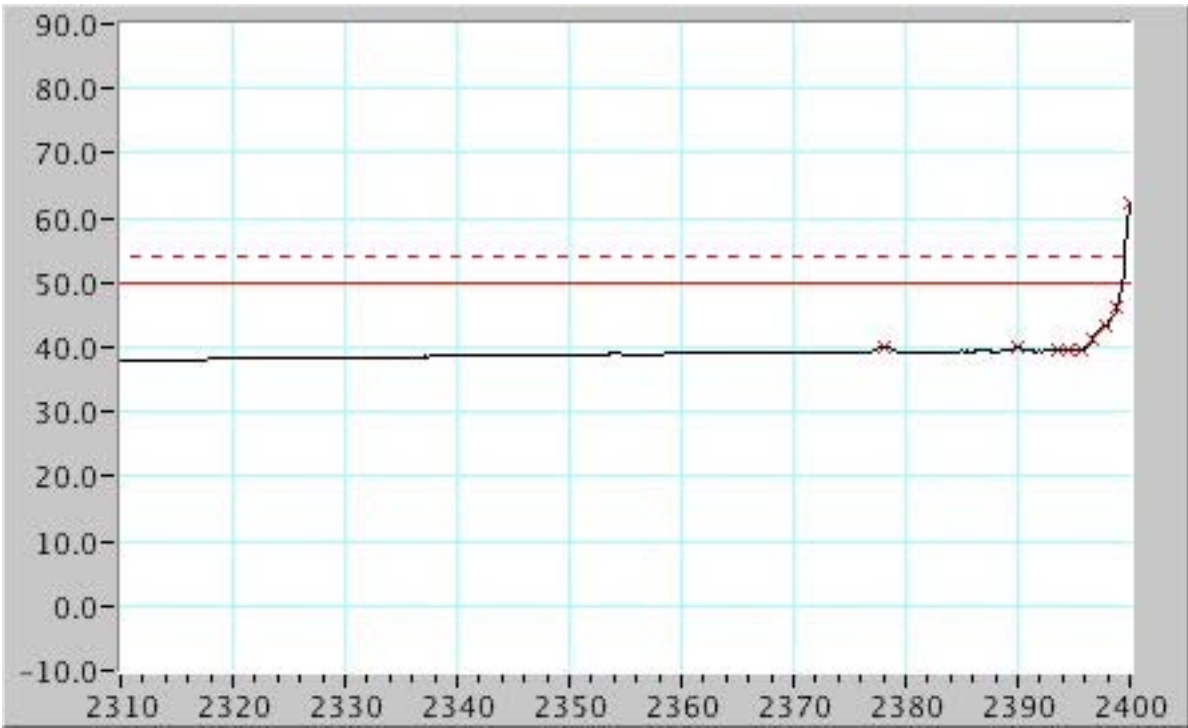
2.3.4 Low Band Edge Results

Peak Measurement, Vertical Polarity



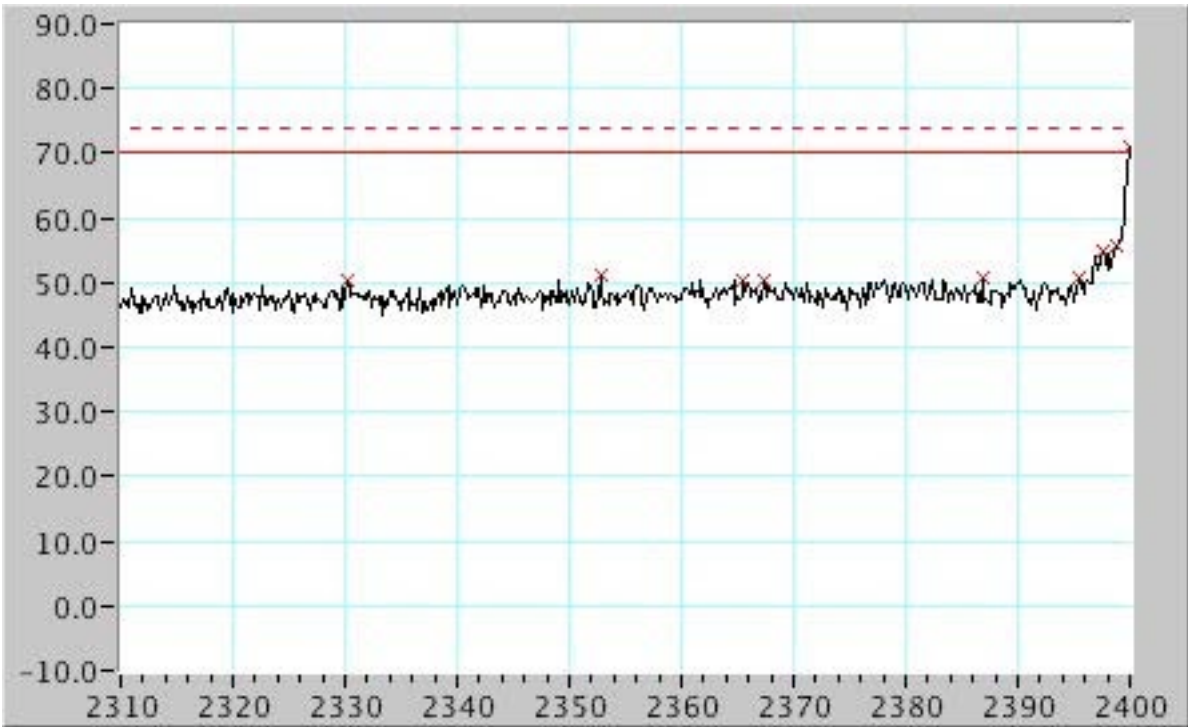
| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2322.8    | 50.6   | 70.0   | -19.4 |
| 2352.7    | 50.3   | 70.0   | -19.7 |
| 2372.6    | 50.9   | 70.0   | -19.1 |
| 2376.9    | 50.1   | 70.0   | -19.9 |
| 2384.1    | 50.3   | 70.0   | -19.7 |
| 2385.8    | 50.7   | 70.0   | -19.3 |
| 2396.9    | 53.2   | 70.0   | -16.8 |
| 2398.7    | 54.6   | 70.0   | -15.4 |
| 2400.0    | 67.7   | 70.0   | -2.3  |

Average Measurement, Vertical Polarity



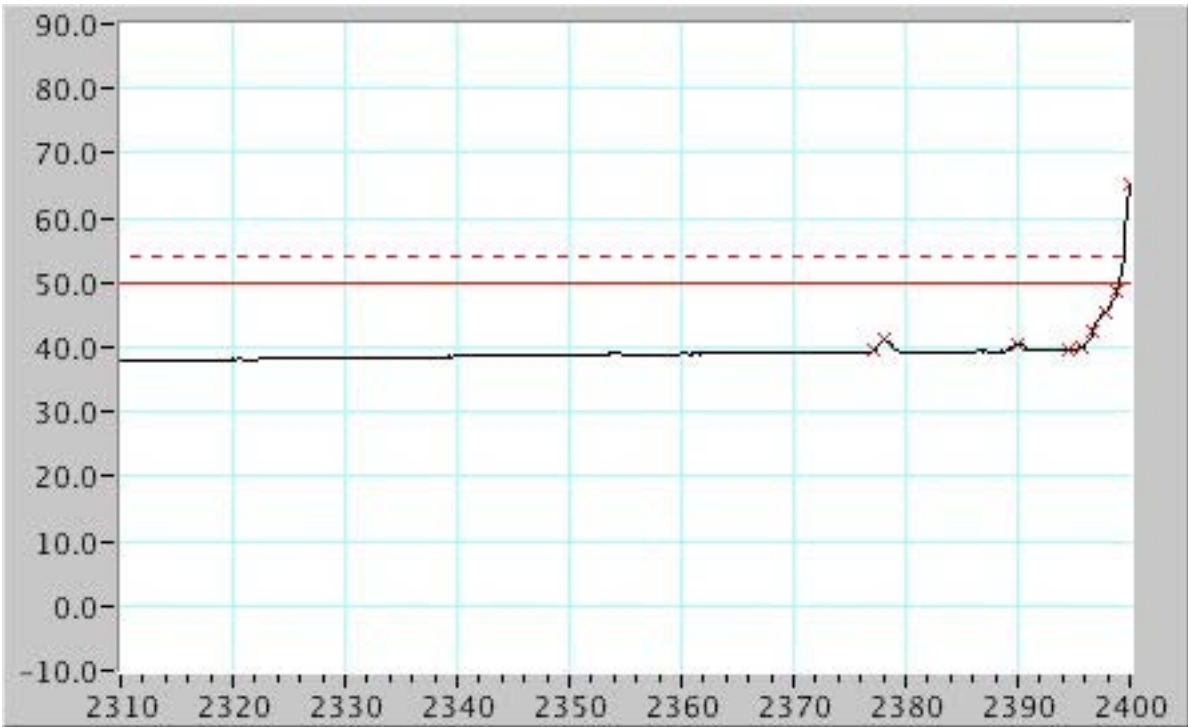
| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2378.2    | 40.1   | 50.0   | -9.9  |
| 2390.1    | 39.9   | 50.0   | -10.1 |
| 2393.5    | 39.5   | 50.0   | -10.5 |
| 2394.6    | 39.5   | 50.0   | -10.5 |
| 2395.7    | 39.7   | 50.0   | -10.3 |
| 2396.8    | 41.3   | 50.0   | -8.7  |
| 2397.8    | 43.3   | 50.0   | -6.7  |
| 2398.9    | 46.2   | 50.0   | -3.8  |
| 2400.0    | 62.3   | 50.0   | 12.3  |

Peak Measurement, Horizontal Polarity



| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2330.2    | 50.5   | 70.0   | -19.5 |
| 2352.7    | 51.1   | 70.0   | -18.9 |
| 2365.6    | 50.3   | 70.0   | -19.7 |
| 2367.4    | 50.5   | 70.0   | -19.5 |
| 2386.8    | 50.9   | 70.0   | -19.1 |
| 2395.5    | 50.7   | 70.0   | -19.3 |
| 2397.7    | 55.0   | 70.0   | -15.0 |
| 2398.9    | 55.6   | 70.0   | -14.4 |
| 2400.0    | 71.1   | 70.0   | 1.1   |

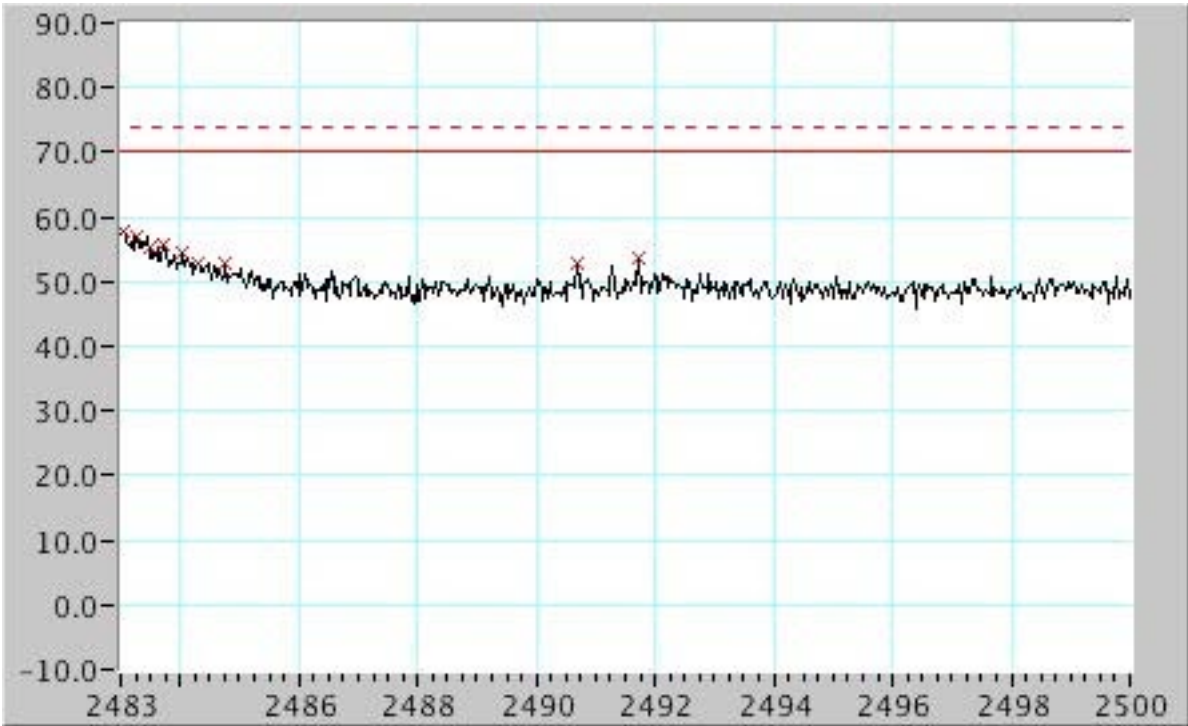
Average Measurement, Horizontal Polarity



| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2377.1    | 39.5   | 50.0   | -10.5 |
| 2378.2    | 41.1   | 50.0   | -8.9  |
| 2390.1    | 40.4   | 50.0   | -9.6  |
| 2394.6    | 39.6   | 50.0   | -10.4 |
| 2395.7    | 39.9   | 50.0   | -10.1 |
| 2396.8    | 42.7   | 50.0   | -7.3  |
| 2397.8    | 45.4   | 50.0   | -4.6  |
| 2398.9    | 48.8   | 50.0   | -1.2  |
| 2400.0    | 65.1   | 50.0   | 15.1  |

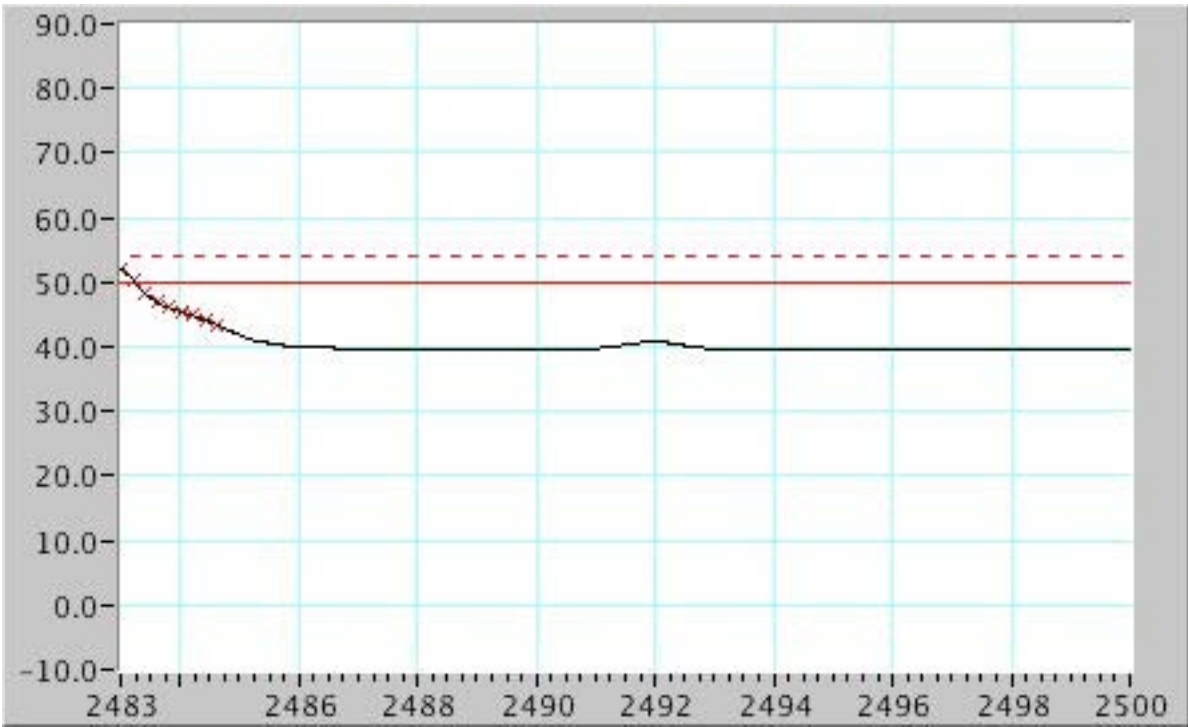
2.3.4 High Band Edge Results

Peak Measurement, Vertical Polarity



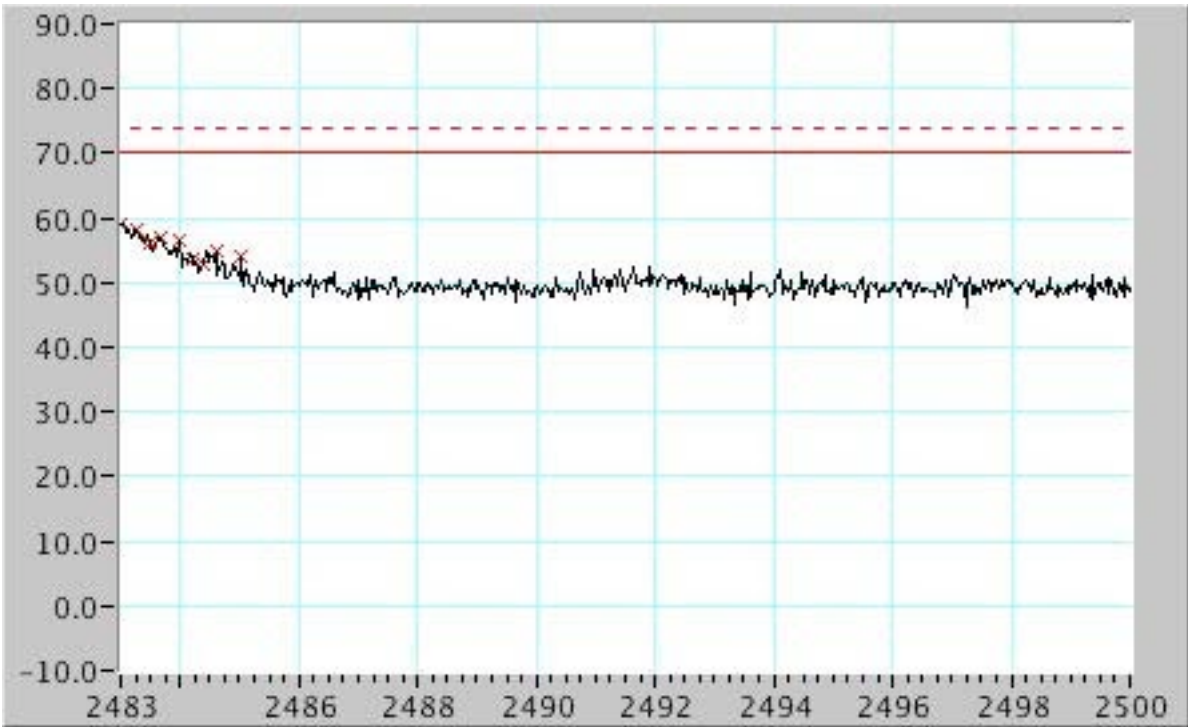
| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2483.0    | 57.7   | 70.0   | -12.3 |
| 2483.3    | 57.0   | 70.0   | -13.0 |
| 2483.5    | 55.5   | 70.0   | -14.5 |
| 2483.7    | 55.8   | 70.0   | -14.2 |
| 2484.1    | 54.6   | 70.0   | -15.4 |
| 2484.3    | 53.0   | 70.0   | -17.0 |
| 2484.8    | 53.0   | 70.0   | -17.0 |
| 2490.7    | 52.6   | 70.0   | -17.4 |
| 2491.7    | 53.6   | 70.0   | -16.4 |

Average Measurement, Vertical Polarity



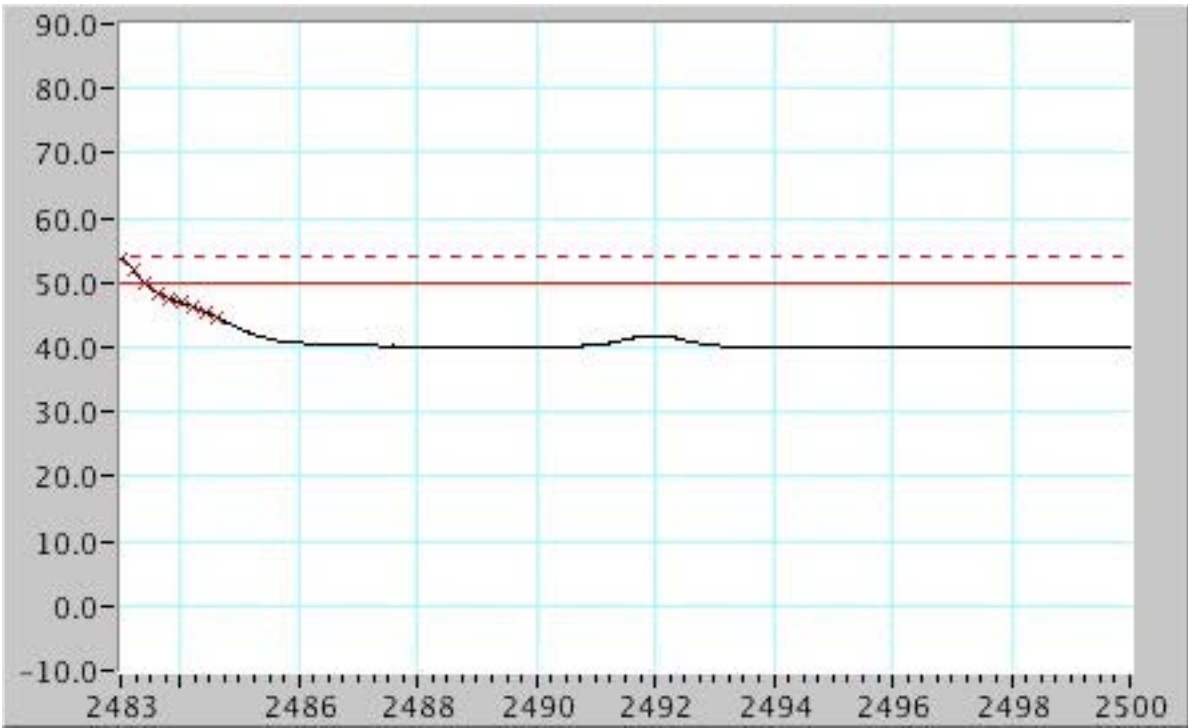
| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2483.0    | 51.9   | 50.0   | 1.9   |
| 2483.2    | 50.2   | 50.0   | 0.2   |
| 2483.4    | 48.2   | 50.0   | -1.8  |
| 2483.6    | 46.9   | 50.0   | -3.1  |
| 2483.8    | 46.0   | 50.0   | -4.0  |
| 2484.0    | 45.4   | 50.0   | -4.6  |
| 2484.2    | 44.8   | 50.0   | -5.2  |
| 2484.4    | 44.1   | 50.0   | -5.9  |
| 2484.6    | 43.3   | 50.0   | -6.7  |

Peak Measurement, Horizontal Polarity



| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2483.0    | 59.2   | 70.0   | -10.8 |
| 2483.3    | 58.3   | 70.0   | -11.7 |
| 2483.5    | 56.0   | 70.0   | -14.0 |
| 2483.7    | 57.0   | 70.0   | -13.0 |
| 2484.0    | 56.7   | 70.0   | -13.3 |
| 2484.2    | 53.6   | 70.0   | -16.4 |
| 2484.4    | 52.9   | 70.0   | -17.1 |
| 2484.6    | 55.1   | 70.0   | -14.9 |
| 2485.0    | 53.9   | 70.0   | -16.1 |

Average Measurement, Horizontal Polarity

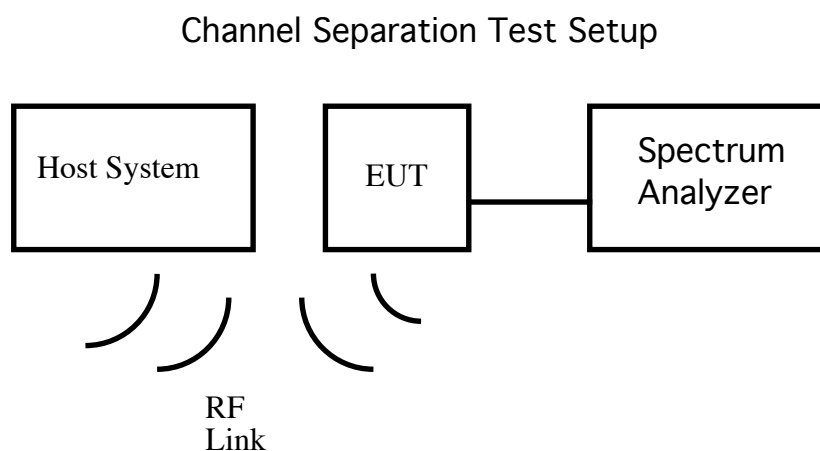


| Frequency | Level  | Limit  | Delta |
|-----------|--------|--------|-------|
| MHz       | dBuV/m | dBuV/m | dB    |
| 2483.0    | 53.6   | 50.0   | 3.6   |
| 2483.2    | 51.9   | 50.0   | 1.9   |
| 2483.4    | 49.9   | 50.0   | -0.1  |
| 2483.6    | 48.4   | 50.0   | -1.6  |
| 2483.8    | 47.5   | 50.0   | -2.5  |
| 2484.0    | 46.8   | 50.0   | -3.2  |
| 2484.2    | 46.2   | 50.0   | -3.8  |
| 2484.4    | 45.4   | 50.0   | -4.6  |
| 2484.6    | 44.6   | 50.0   | -5.4  |

### 3 CFR 15.247(a)(1) Channel Separation

#### 3.1 CFR 15.247(a)(1) Channel Separation Test Setup Block Diagram

The channel separation for frequency hopping systems shall be a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. The 20 dB bandwidth of the Apple Bluetooth keyboard 891 kHz (See section 6 in this test report). The Setup for measuring the channel separation is depicted in the figure below.



#### 3.2 CFR 15.247(a)(1) Channel Separation Test Procedures

The transmitter output is connected to the spectrum analyzer RF input. The bandwidth of the spectrum analyzer was set to 30 kHz.

#### 3.3 CFR 15.247(a)(1) Channel Separation Test Equipment

| Description       | Manufacturer | Model No. | Identification No. | Last Cal     | Next Cal     |
|-------------------|--------------|-----------|--------------------|--------------|--------------|
| Spectrum Analyzer | R&S          | ESIB 40   | 100105             | August, 2002 | August, 2003 |

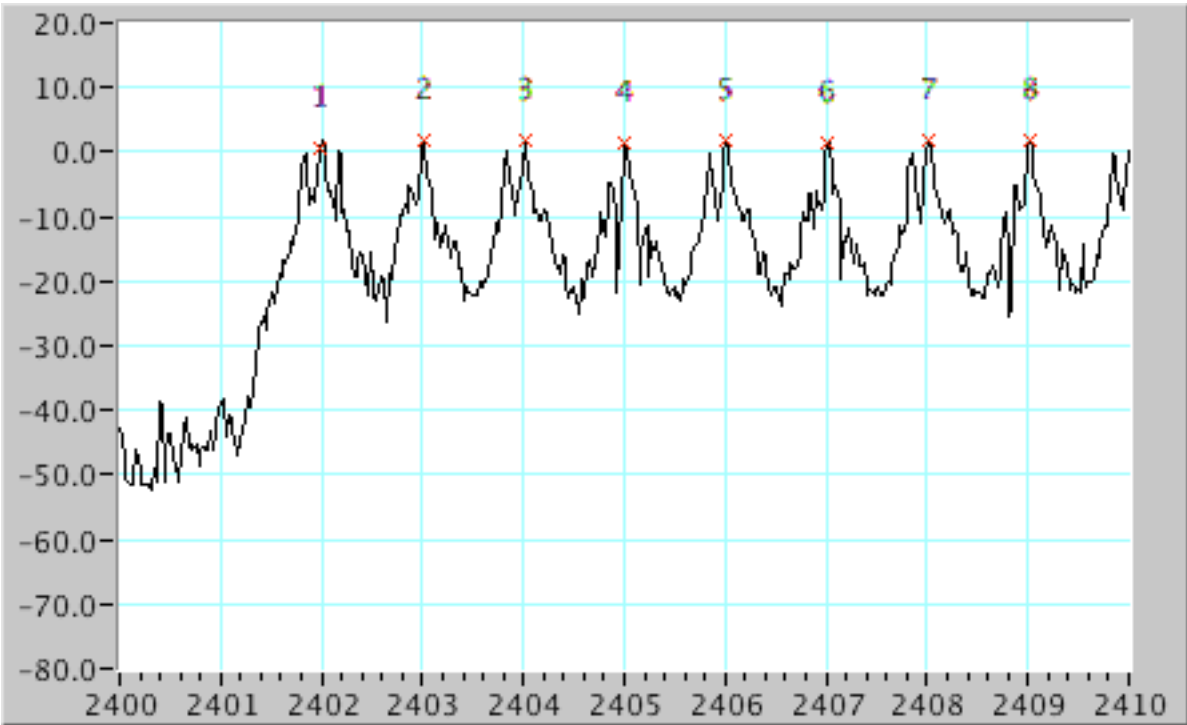
##### 4.3.1 CFR 15.247(a)(1) Channel Separation Instrument Settings

| Instrument Settings |             |               |          |             |        |
|---------------------|-------------|---------------|----------|-------------|--------|
| Reference Level     | Attenuation | Resolution BW | Video BW | Sweep Rate  | Span   |
| 20 dBm              | 30 dB       | 30 kHz        | 30 kHz   | 200 Seconds | 10 MHz |

3.4 CFR 15.247(a)(1) Channel Separation EUT Operating Conditions

Using special test software, the Apple Bluetooth keyboard was placed in continous hopping mode across all 79 hopping channels.

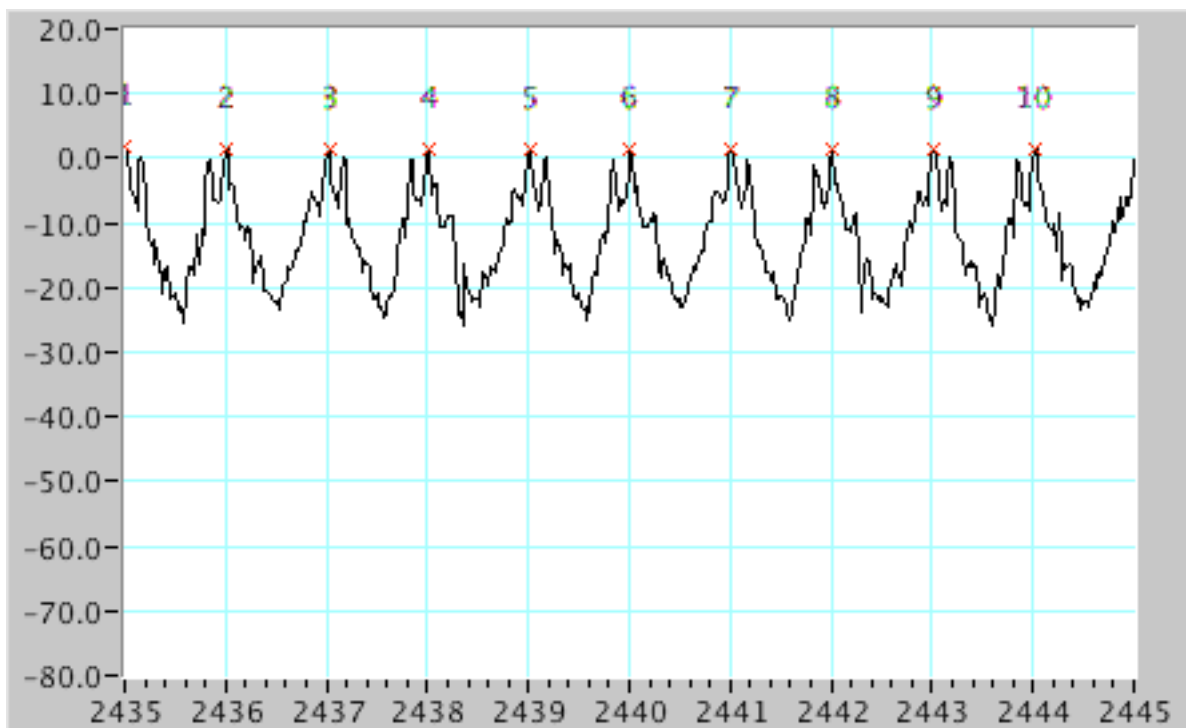
3.5 CFR 15.247(a)(1) Channel Separation - Lower Channels



| Marker | Frequency (GHz) |
|--------|-----------------|
| 1      | 2402.0          |
| 2      | 2403.0          |
| 3      | 2404.0          |
| 4      | 2405.0          |
| 5      | 2406.0          |
| 6      | 2407.0          |
| 7      | 2408.0          |
| 8      | 2409.0          |

*Channel Spacing greater than 25kHz and 20dB bandwidth in all instances*

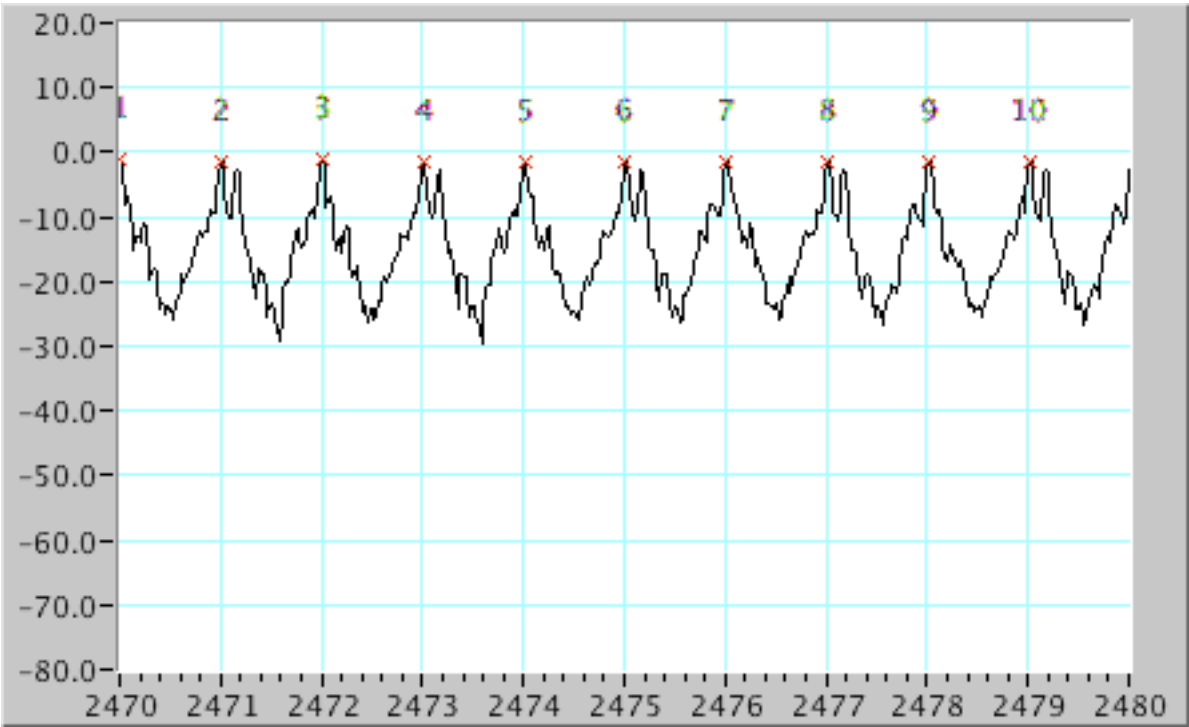
### 3.6 CFR 15.247(a)(1) Mid Channels Channel Separation



| Marker | Frequency (GHz) |
|--------|-----------------|
| 1      | 2435.0          |
| 2      | 2436.0          |
| 3      | 2437.0          |
| 4      | 2438.0          |
| 5      | 2439.0          |
| 6      | 2441.0          |
| 7      | 2441.0          |
| 8      | 2442.0          |
| 9      | 2443.0          |
| 10     | 2444.0          |

*Channel Spacing greater than 25kHz and 20dB bandwidth in all instances*

3.7 CFR 15.247(a)(1) High Channels Channel Separation



| Marker | Frequency (GHz) |
|--------|-----------------|
| 1      | 2470.0          |
| 2      | 2471.0          |
| 3      | 2472.0          |
| 4      | 2473.0          |
| 5      | 2474.0          |
| 6      | 2475.0          |
| 7      | 2476.0          |
| 8      | 2477.0          |
| 9      | 2478.0          |
| 10     | 2479.0          |

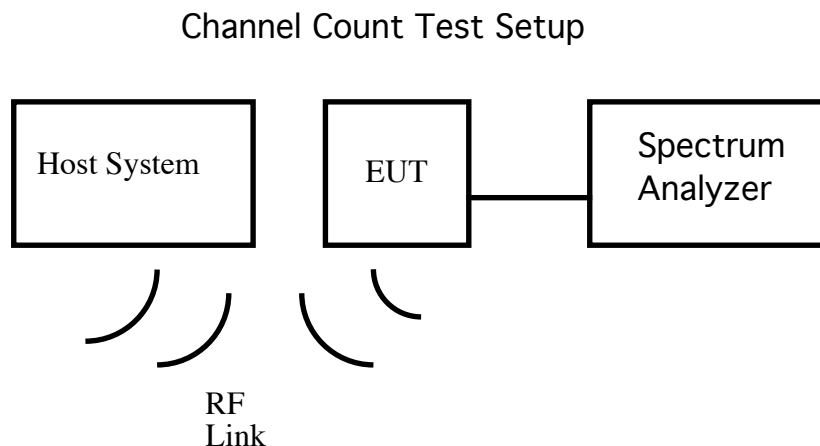
Channel Spacing greater than 25kHz and 20dB bandwidth in all instances

**Result:** The channel separation for the low, mid and high channels is greater then the minimum as defined by the 20 dB bandwidth.

**Conclusion:** PASS

**4 CFR 15.247(a)(1) Number of Hopping Frequencies****4.1 CFR 15.247(a)(1) Number of Hopping Frequencies Setup Block Diagram**

The minimum number of Hopping frequencies is 75. The Setup for measuring the number of hopping frequencies is depicted in the figure below.

**4.2 CFR 15.247(a)(1) Number of Hopping Frequencies Test Procedures**

The transmitter output is connected to the spectrum analyzer RF input. An RF link was established using special software which enabled a chat mode. All channels were enabled. Using the spectrum analyzer settings shown below, record the RF emissions over the frequency range of 2400 MHz to 2485.3 MHz.

**4.3 CFR 15.247(a)(1) Number of Hopping Frequencies Test Procedures Test Equipment**

| Description       | Manufacturer | Model No. | Identification No. | Last Cal  | Next Cal  |
|-------------------|--------------|-----------|--------------------|-----------|-----------|
| Spectrum Analyzer | R&S          | ESIB 40   | 100105             | May, 2003 | May, 2004 |

**4.3.1 CFR 15.247(a)(1) Number of Hopping Frequencies Test Procedures Instrument Settings**

| Instrument Settings |             |               |          |             |         |
|---------------------|-------------|---------------|----------|-------------|---------|
| Reference Level     | Attenuation | Resolution BW | Video BW | Sweep Rate  | Span    |
| 20 dBm              | 30 dB       | 100 kHz       | 100 kHz  | 100 Seconds | 20 MHz* |

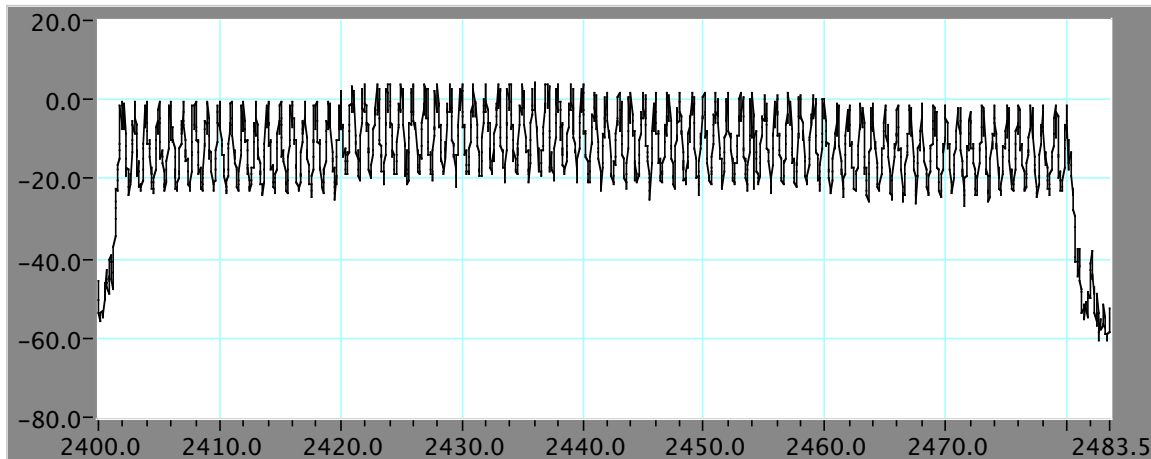
\*The frequency range of 2460 to 2483.5 MHz was measured using a 23.5 MHz span.

**4.4 CFR 15.247(a)(1) Number of Hopping Frequencies EUT Operating Conditions**

Using special test software, the Apple Bluetooth keyboard was placed in continuous hopping mode.

**4.5 CFR 15.247(a)(1) Number of Hopping Frequencies Test Results**

Measurements were performed over 4 band of approximately 20 MHz each. The graphical data of the 4 bands was combined and is displayed below. A total of 79 equally spaced channels were detected. The graph below shows the results of the measurement of the number of hopping frequencies on the Apple Bluetooth keyboard.



**Result: The number of hopping channels is greater then 75.**

**Conclusion: PASS**

**5 CFR 15.247(a)(1)(ii) 20 dB Bandwidth**

The Maximum 20 dB bandwidth of the hopping channel is 1 MHz.

**5.1 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Test Setup**

20 dB Bandwidth measurements were performed at the Apple Computer EMC lab located at 20650 Valley Green Drive. The EUT was placed on a nonmetallic table. The EUT and peripherals were powered from a filtered main supply.

**5.2 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Test Procedure**

20 dB Bandwidth Measurements were performed with the transmitter frequency set to the low, mid and high channels using special OS X test software called RFTTestApp. The -20 dBc Spurious Emissions data is provided in this report for each case.

- low channel - 2.402 GHz
- mid channel - 2.441 GHz
- high channel - 2.480 GHz

**5.3 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Test Equipment**

The following test equipment was used when performing 20 dB Bandwidth tests.

| Description       | Manufacturer | Model No. | Identification No. | Last Cal     | Next Cal     |
|-------------------|--------------|-----------|--------------------|--------------|--------------|
| Spectrum Analyzer | R&S          | ESIB 40   | 100105             | August, 2002 | August, 2003 |

**5.3.1 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Instrument Settings**

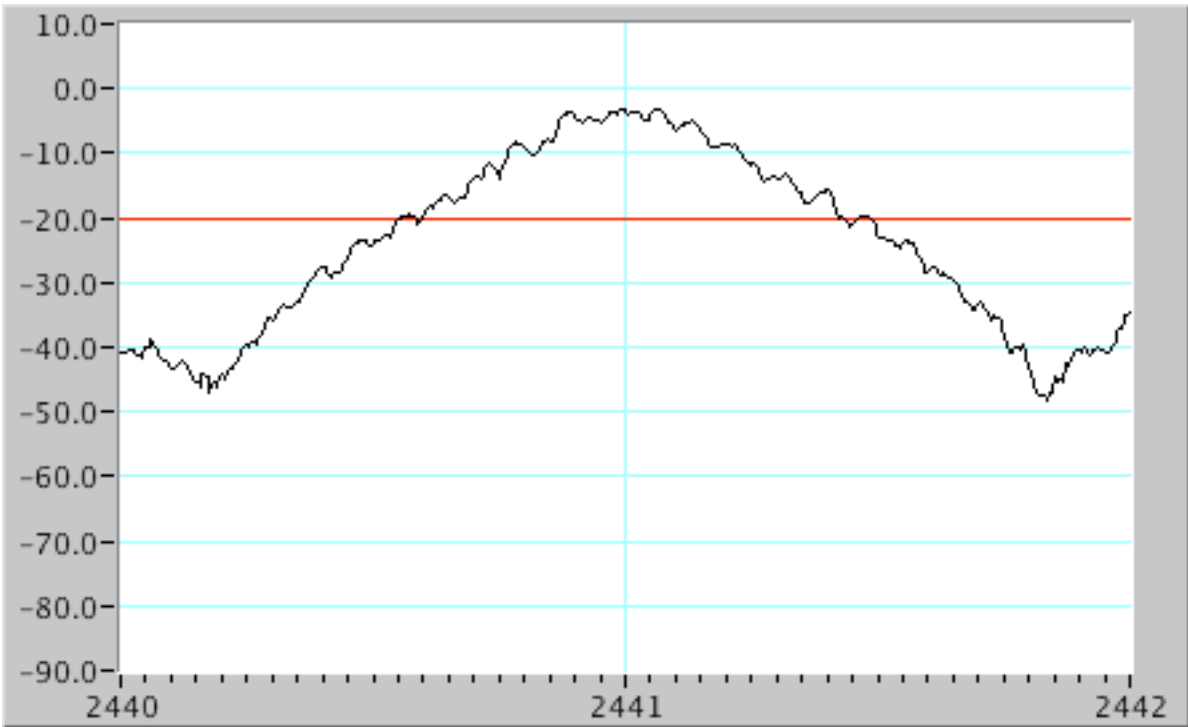
| Instrument Settings |               |          |                 |             |             |
|---------------------|---------------|----------|-----------------|-------------|-------------|
| Frequency Range     | Resolution BW | Video BW | Reference Level | Attenuation | Sweep Time  |
| 2.4 GHz - 2.483 GHz | 30 kHz        | 300 kHz  | 0 dBm           | 10 dB       | 50 mSeconds |

**5.4 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Test Results**

The Apple Bluetooth keyboard complies with the 20 dB Bandwidth requirements. The results are listed in the table below.

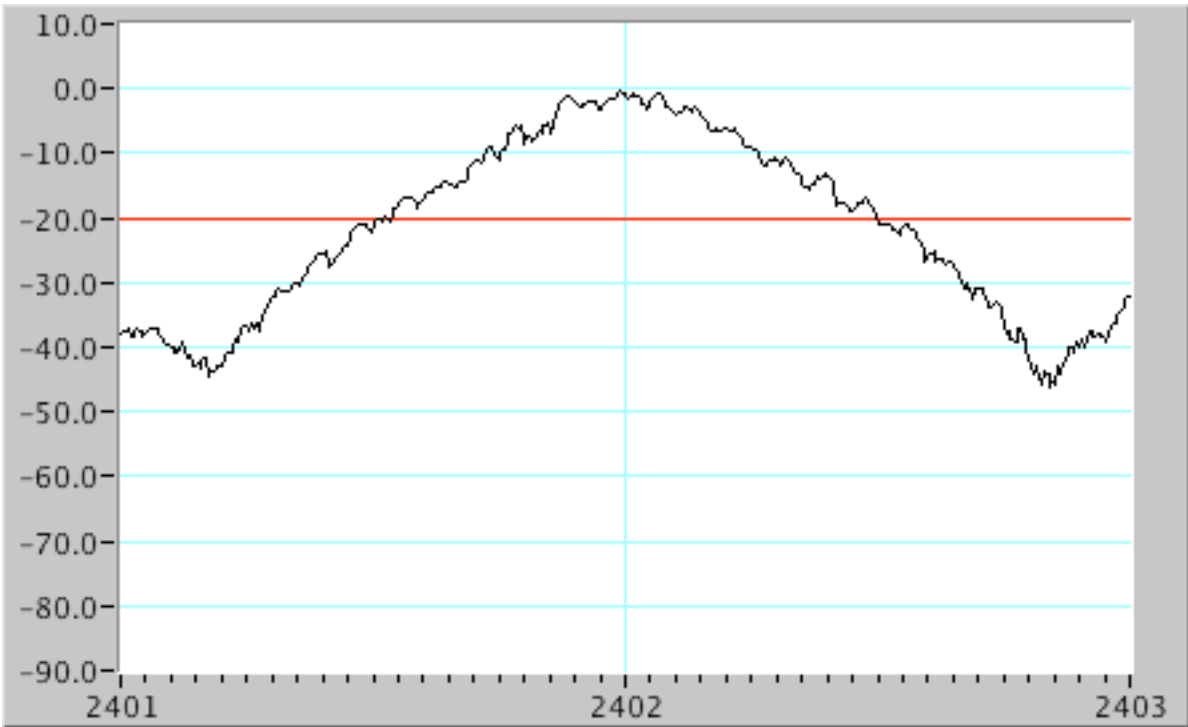
| Channel | 20 dB Bandwidth |
|---------|-----------------|
| 1       | 960 kHz         |
| 40      | 860 kHz         |
| 79      | 950 kHz         |

5.5 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Channel 1



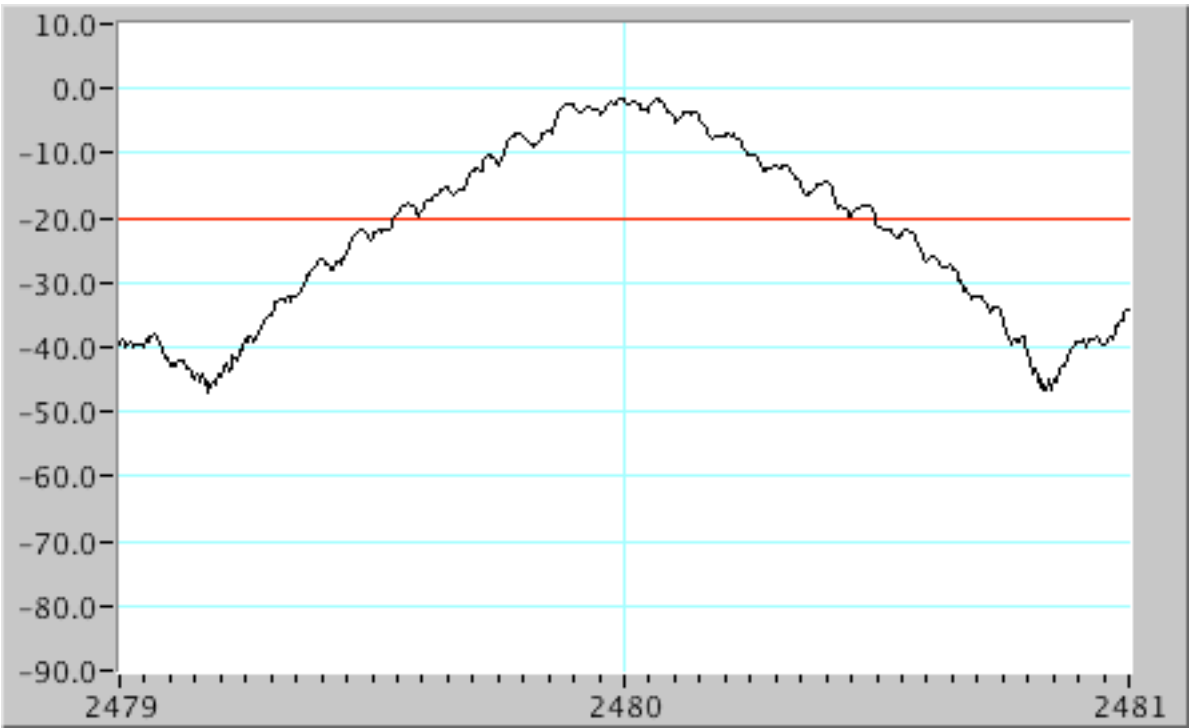
|              |              |                 |
|--------------|--------------|-----------------|
| -20dBc Point | -20dBc Point | 20 dB Bandwidth |
| 2401.53 MHz  | 2402.49 MHz  | 960 kHz         |

5.6 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Channel 40



|               |               |                 |
|---------------|---------------|-----------------|
| -20 dBc Point | -20 dBc Point | 20 dB Bandwidth |
| 2441.56 MHz   | 2441.42 MHz   | 860 kHz         |

5.7 CFR 15.247(a)(1)(ii) 20 dB Bandwidth Channel 79

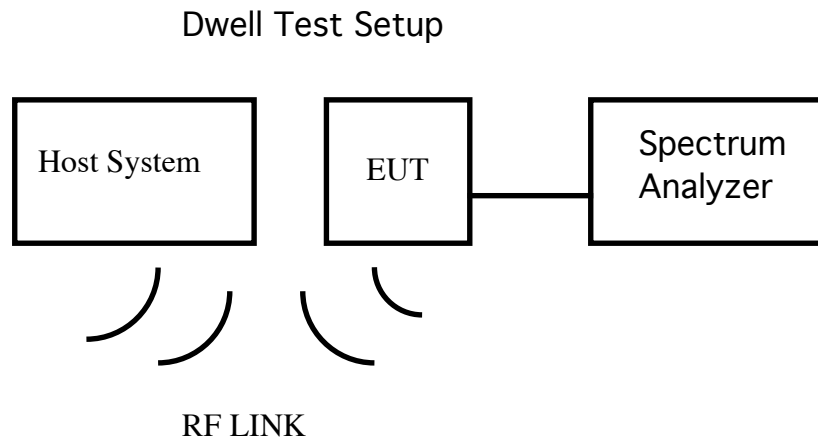


|               |               |                 |
|---------------|---------------|-----------------|
| -20 dBc Point | -20 dBc Point | 20 dB Bandwidth |
| 2479.54 MHz   | 2480.49 MHz   | 950 kHz         |

Result: The 20 dB channel bandwidth is less then 1 MHz  
Conclusion: PASS

**6 CFR 15.247(a)(1)(ii) Dwell Time****6.1 CFR 15.247(a)(1)(ii) Dwell Time Setup Block Diagram**

The maximum dwell time within any 30 second period is 0.4 Seconds. The Setup for measuring the dwell is depicted in the figure below.

**6.2 CFR 15.247(a)(1)(ii) Dwell Time Test Procedures**

The transmitter output is connected to the spectrum analyzer RF input. The bandwidth of the spectrum analyzer was set to 100 kHz. The 6 dB bandwidth of the transmitter is defined as the portion of the signal which is higher than the peak signal minus 6 dB.

**6.3 CFR 15.247(a)(1)(ii) Dwell Time Test Equipment**

| Description       | Manufacturer | Model No. | Identification No. | Last Cal  | Next Cal  |
|-------------------|--------------|-----------|--------------------|-----------|-----------|
| Spectrum Analyzer | R&S          | ESIB 40   | 100105             | May, 2002 | May, 2003 |

**6.3.1 CFR 15.247(a)(1)(ii) Dwell Time Instrument Settings**

| Instrument Settings |             |               |          |            |      |
|---------------------|-------------|---------------|----------|------------|------|
| Reference Level     | Attenuation | Resolution BW | Video BW | Sweep Rate | Span |
| 10 dBm              | 30 dB       | 100 kHz       | 100 kHz  | 5 mSeconds | 0 Hz |

**6.4 CFR 15.247(a)(1)(ii) Dwell Time EUT Operating Conditions**

Using special test software, the Apple Bluetooth keyboard was placed in hopping mode and the low, mid, high channels were monitored.

**6.5 CFR 15.247(a)(1)(ii) Dwell Time Test Results**

The single channel dwell time for each of the channels is well under the 0.4 Second limit. An explanation of how the results were arrived at is provided below.

The dwell time over a 30 second period can be calculated by measuring the pulse duration of a single hop and multiplying that measurement by the hopping rate and the 30 second period and then dividing by the number of channels. The Apple Bluetooth keyboard hops over 79 channels. The maximum hopping rate is 1600 hops/second. A sample calculation is provided:

$$(\text{Single Hop Dwell} * \text{Hopping Rate}) / (\text{Total number of Channels}) * \text{Period} = \text{Total Dwell Time}$$

$$(0.00012 * 1600) / 79 * 30 = 0.073 \text{ Seconds}$$

The dwell time results are summarized in the table below.

| Channel | Single Hop Dwell  | Hopping Rate  | Total number of Channels | Period     | Total Single Channel 30 Second Dwell Time | Maximum Dwell time Limit |
|---------|-------------------|---------------|--------------------------|------------|-------------------------------------------|--------------------------|
| 2402    | 120 $\mu$ Seconds | 1600 hops/Sec | 79                       | 30 Seconds | 0.073 Seconds                             | 0.4 Seconds              |
| 2441    | 140 $\mu$ Seconds | 1600 hops/Sec | 79                       | 30 Seconds | 0.085 Seconds                             | 0.4 Seconds              |
| 2480    | 140 $\mu$ Seconds | 1600 hops/Sec | 79                       | 30 Seconds | 0.085 Seconds                             | 0.4 Seconds              |

Below are the measured pulse duration of a single hop for 3 channels. Measurements were performed at the low, mid and highest channel.

**DUTY CYCLE COMPENSATION FACTOR**

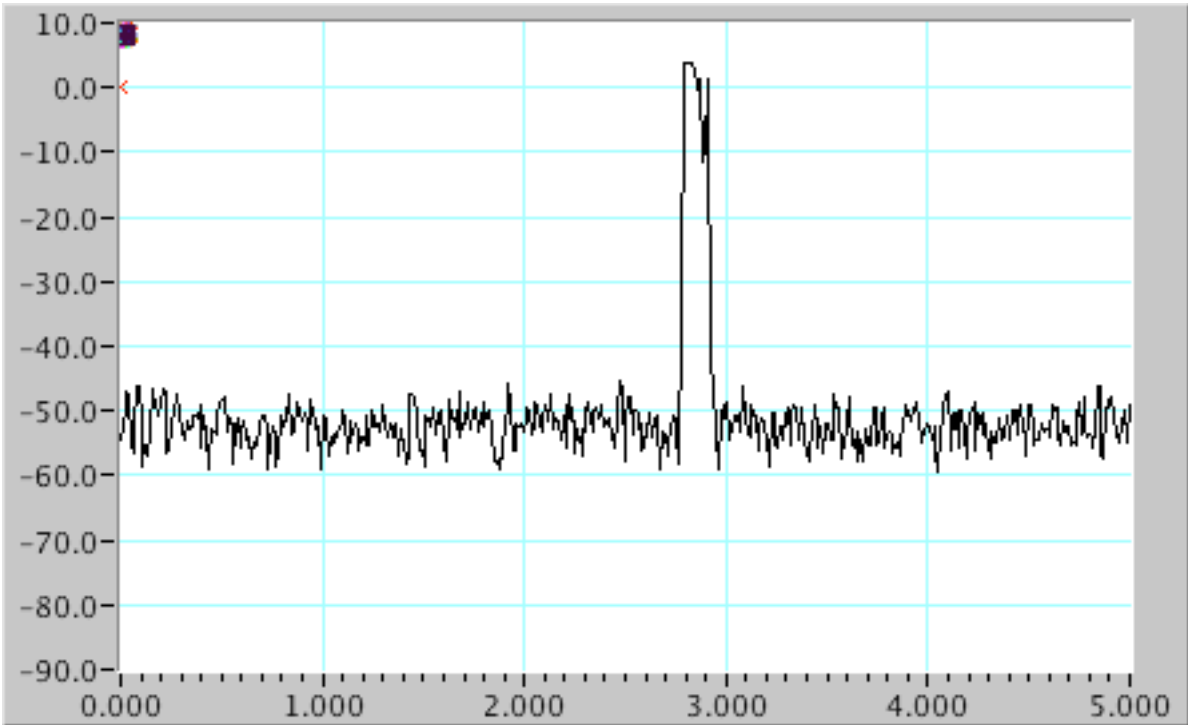
(as described in "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems", DA 00-705, Released March 30, 2000)

$$\text{Compensation Factor} = 20 * \log(\text{dwell time in 100 ms interval} / 100\text{ms})$$

*looking at pg.44-46, the single hop dwell is found in a 5ms span. If we multiply this value by twenty, we will have the dwell time in a 100ms span.*

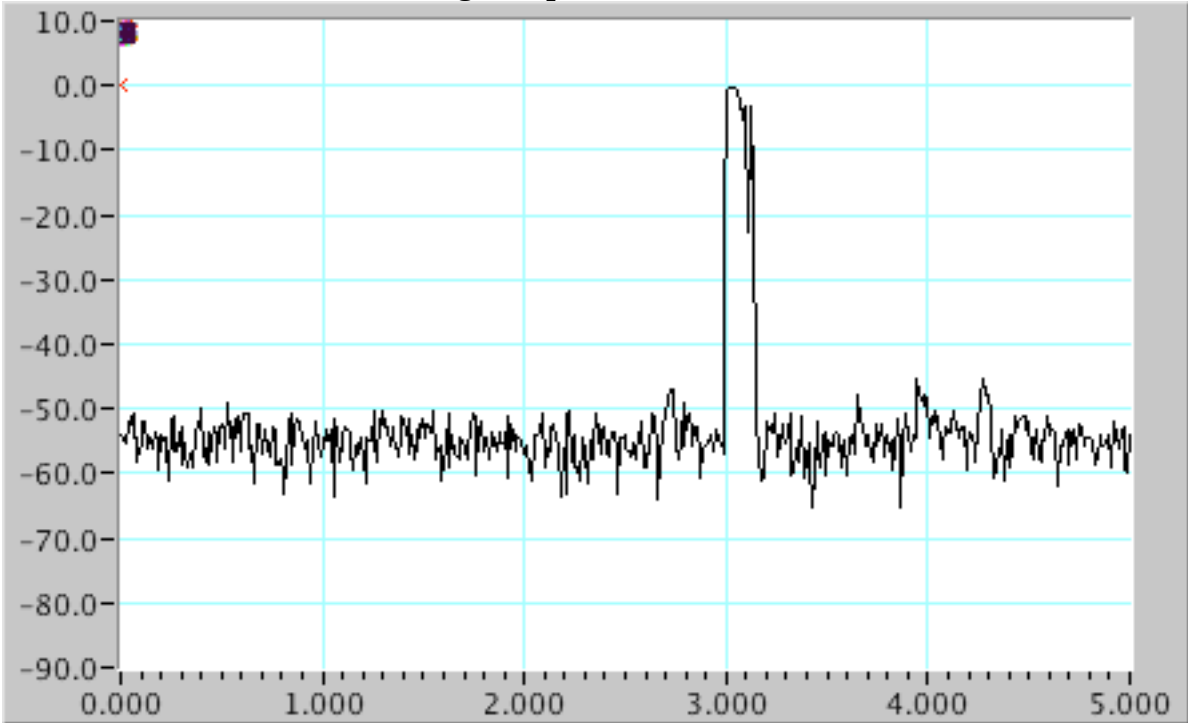
| Channel (MHz) | 5ms interval dwell | 100ms interval dwell | Compensation Factor                   |
|---------------|--------------------|----------------------|---------------------------------------|
| 2402          | 120 $\mu$ Seconds  | 2.4 ms               | $20 * \log(2.4/100) = -32.4\text{dB}$ |
| 2441          | 140 $\mu$ Seconds  | 2.8 ms               | $20 * \log(2.8/100) = -31.1\text{dB}$ |
| 2480          | 140 $\mu$ Seconds  | 2.8 ms               | $20 * \log(2.8/100) = -31.1\text{dB}$ |

6.6 CFR 15.247(a)(1)(ii) Channel 1 Single Hop Dwell Time



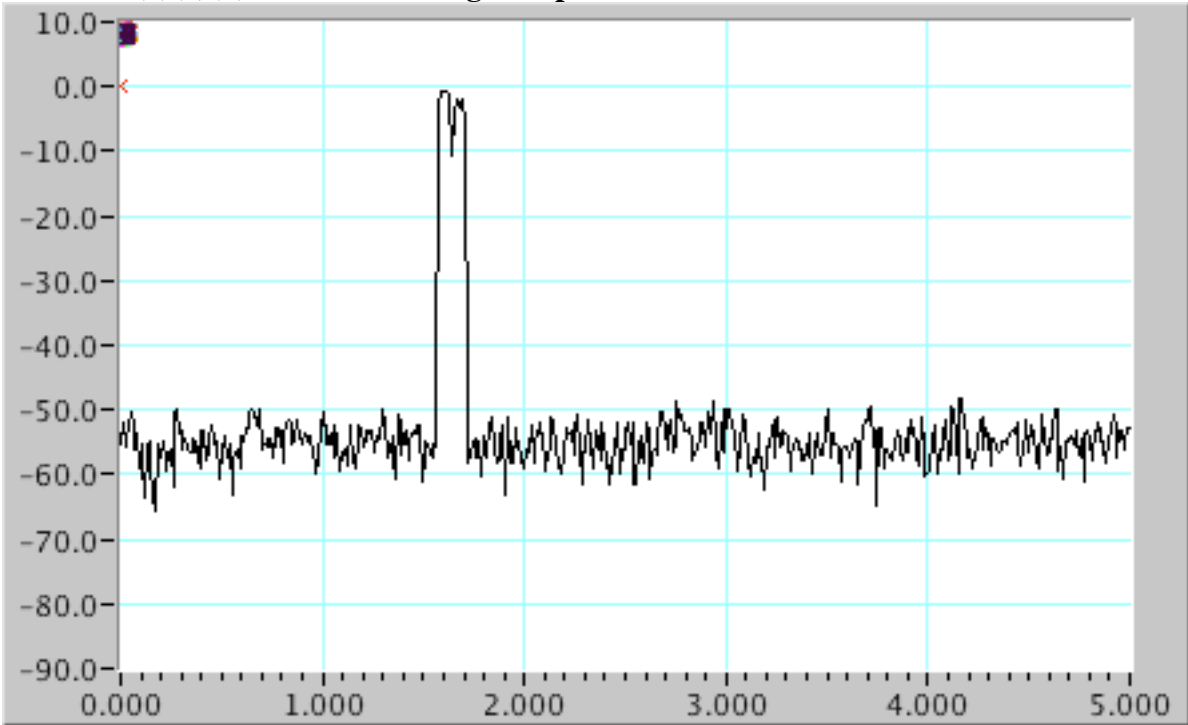
| Frequency | Marker 1 | Marker 2 | Single Hop Dwell |
|-----------|----------|----------|------------------|
| 2402 MHz  | 1.774ms  | 1.894ms  | 120 μSeconds     |

6.7 CFR 15.247(a)(1)(ii) channel 40 Single Hop Dwell Time



|           |          |          |                  |
|-----------|----------|----------|------------------|
| Frequency | Marker 1 | Marker 2 | Single Hop Dwell |
| 2441 MHz  | 2.996ms  | 3.136ms  | 140μSeconds      |

6.8 CFR 15.247(a)(1)(ii) Channel 79 Single Hop Dwell Time

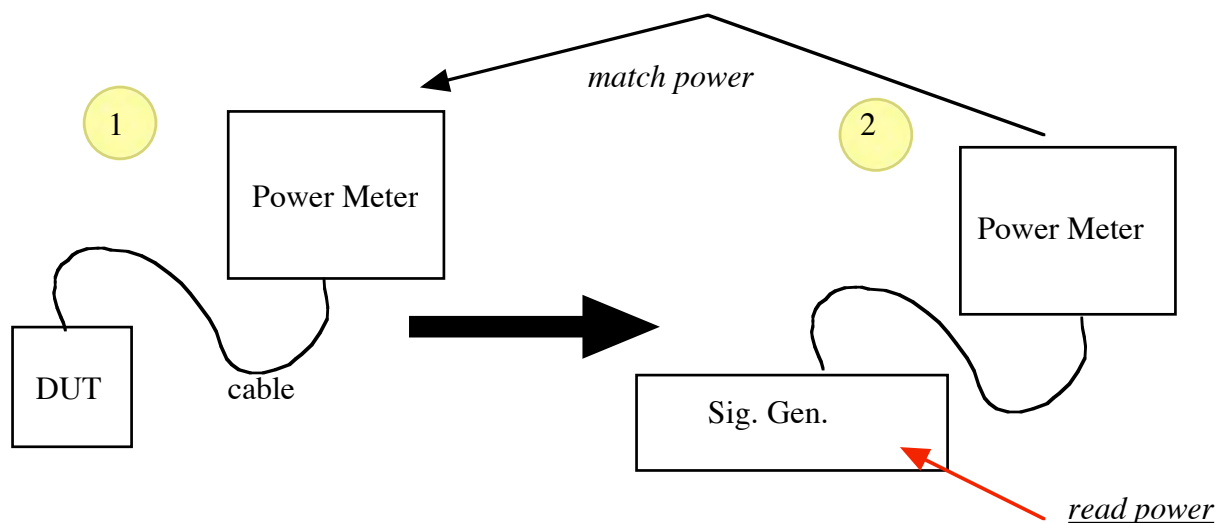


|           |                |                |                  |
|-----------|----------------|----------------|------------------|
| Frequency | Marker 1       | Marker 2       | Single Hop Dwell |
| 2480 MHz  | 1.573 mSeconds | 1.713 mSeconds | 140 μSeconds     |

**Result:** The maximum dwell time is less then 0.4 Seconds.  
**Conclusion:** PASS

**7 CFR 15.247(b)(1)Maximum Power Output****7.1 CFR 15.247(b)(1)Maximum Power Output Test Setup**

The maximum power output was found using the substitution method. First, the TX output from the mouse was connected to a power meter and this output power was noted. Next, a carrier wave from the signal generator using the same cables and set to the mouse carrier frequency was varied in power until it matched the recorded power from the last step. This carrier power from the signal generator represents the conducted output power from the mouse.

**7.2 CFR 15.247(b)(1)Maximum Power Output Test Procedures**

The transmitter output is connected to the power meter RF input. The power is measured with the transmitter set to 3 channels, low, mid and high.

**7.3 CFR 15.247(b)(1)Maximum Power Output Test Equipment**

| Description | Manufacturer | Model No.  | Identification No. | Last Cal  | Next Cal  |
|-------------|--------------|------------|--------------------|-----------|-----------|
| Sig Gen     | R&S          | 13054-4523 | 13054-4523         | May, 2003 | May, 2004 |
| Power Meter | HP           | 4358       | 1995 100           | May, 2002 | May, 2004 |

**7.4 CFR 15.247(b)(1)Maximum Power Output EUT Operating Conditions**

The transmitter was set to transmit continuously at the low, mid and high channels.

**7.5 CFR 15.247(b)(1)Maximum Power Output - Channels 1, 39 and 79**

| Channel | Frequency | Maximum Output Power (1 Mbps) |
|---------|-----------|-------------------------------|
| 1       | 2402 MHz  | 2.2 dBm                       |
| 39      | 2441 MHz  | 2.0 dBm                       |
| 79      | 2480 MHz  | 1.7 dBm                       |

**Results: The maximum power levels are below the 30 dBm Limit**  
**Conclusion: PASS**

## 8 CFR 15.247(b)(4) RF Exposure

SAR tests were performed on the Apple Bluetooth keyboard using the ceramic antenna and again using the PCB dipole antenna. The reports are listed below. These reports demonstrate that the Apple Bluetooth keyboard's RF exposure levels are well under the limit of 1.6 mW/g.

| Description              | Antenna Description | SAR Report Number |
|--------------------------|---------------------|-------------------|
| Apple Bluetooth Keyboard | PCB antenna         | 03U2032-2         |

**9 CFR 15.247(c) -20 dBc Spurious Conducted Emissions****9.1 CFR 15.247(c) -20 dBc Spurious Conducted Emissions Test Setup**

Spurious Emissions measurements were performed at the Apple Computer EMC lab located at 20650 Valley Green Drive. The EUT was placed on a nonmetallic table. The EUT and peripherals were powered from a filtered main supply.

**9.2 CFR 15.247(c) -20 dBc Spurious Conducted Emissions Test Procedure**

The frequency spectrum from 1 GHz to 25 GHz was scanned

Scans were performed with the transmitter frequency set to the low, mid and high channels. The -20 dBc Spurious Emissions data is provided in this report for each case.

- low channel - 2.402 GHz
- mid channel - 2.441 GHz
- high channel - 2.480 GHz

**9.3 CFR 15.247(c) -20 dBc Spurious Conducted Emissions Test Equipment**

The following test equipment was used when performing spurious emissions tests above 1 GHz.

| Description       | Manufacturer | Model No. | Identification No. | Last Cal  | Next Cal  |
|-------------------|--------------|-----------|--------------------|-----------|-----------|
| Spectrum Analyzer | R&S          | ESIB 40   | 100105             | May, 2003 | May, 2004 |

**9.3.1 CFR 15.247(c) -20 dBc Spurious Conducted Emissions Instrument Settings**

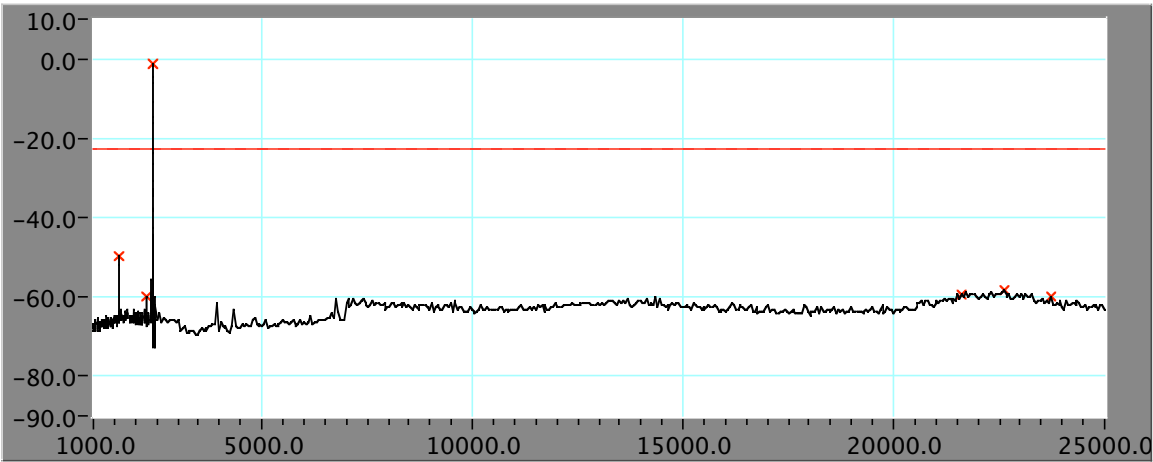
| Instrument Settings |               |          |                 |             |              |
|---------------------|---------------|----------|-----------------|-------------|--------------|
| Frequency Range     | Resolution BW | Video BW | Reference Level | Attenuation | Sweep Time   |
| 1 GHz - 2.4 GHz     | 100 kHz       | 100 kHz  | 20 dBm          | 30 dB       | 350 mSeconds |
| 2.4 GHz - 2.835 GHz | 100 kHz       | 100 kHz  | 20 dBm          | 30 dB       | 100 mSeconds |
| 2.8 GHz - 25 GHz    | 100 kHz       | 100 kHz  | 20 dBm          | 30 dB       | 800 mSeconds |

9.4 CFR 15.247(c) -20 dBc Spurious Conducted Emissions EUT Operating Conditions

The Bluetooth Keyboard was placed in modlated continous transmit on the following channels. Spurius spectral content was observed for each case.

- Channel 1 2402 MHz
- channel 40 2441 MHz
- Channel 79 2480 MHz

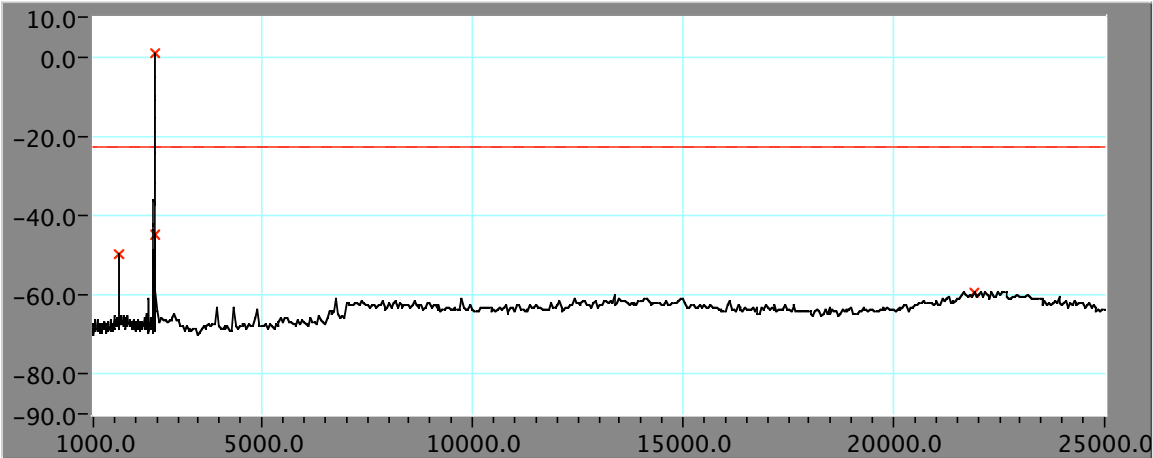
9.5 CFR 15.247(c) -20 dBc Spurious Conducted Emissions -Channel 1 (2.402 GHz)



| Frequency | Level | Limit | Delta |
|-----------|-------|-------|-------|
| MHz       | dBm   | dBm   | dB    |
| 1603.21   | -49.9 | -22.9 | -27.0 |
| 2259.72   | -59.7 | -22.9 | -36.8 |
| 2401.84   | -1.4  | -22.9 | 21.5  |
| 21615.76  | -59.3 | -22.9 | -36.4 |
| 22608.47  | -58.1 | -22.9 | -35.2 |
| 23736.55  | -60.0 | -22.9 | -37.1 |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |

All levels are with a peak detector unless otherwise indicated.

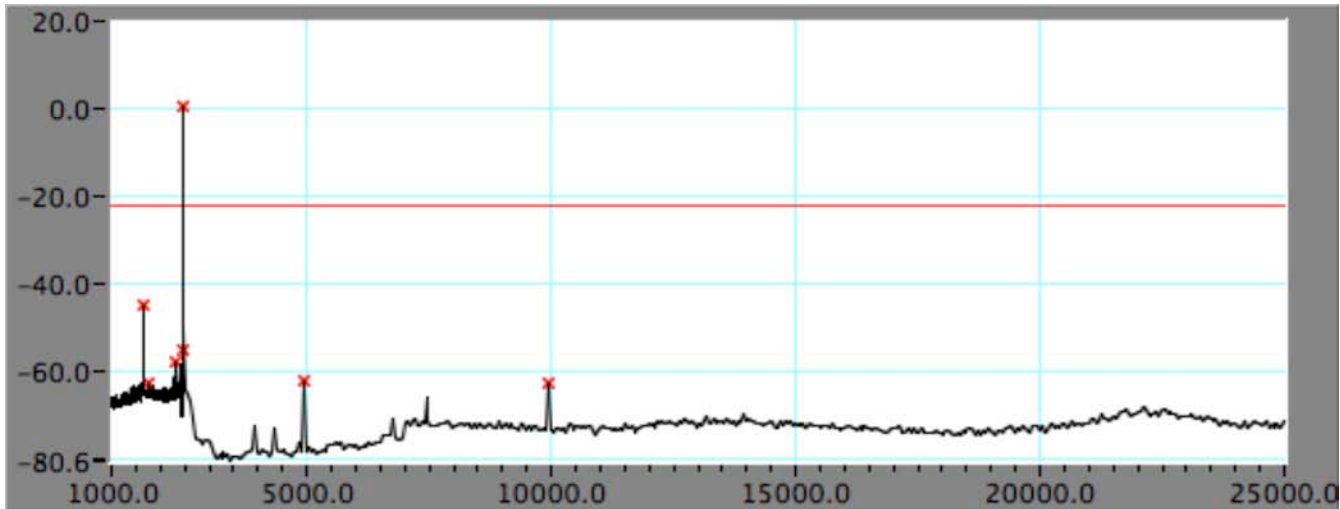
9.6 CFR 15.247(c) -20 dBc Spurious Conducted Emissions - Channel 40 (2.441 GHz)



| Frequency<br>MHz | Level<br>dBm | Limit<br>dBm | Delta<br>dB |
|------------------|--------------|--------------|-------------|
| 1628.46          | -49.5        | -22.9        | -26.6       |
| 2441.00          | 0.9          | -22.9        | 23.8        |
| 2444.51          | -44.8        | -22.9        | -21.9       |
| 21931.62         | -59.2        | -22.9        | -36.3       |
|                  |              |              |             |
|                  |              |              |             |
|                  |              |              |             |
|                  |              |              |             |
|                  |              |              |             |
|                  |              |              |             |
|                  |              |              |             |
|                  |              |              |             |

All levels are with a peak detector unless otherwise indicated.

9.7 CFR 15.247(c) -20 dBc Spurious Conducted Emissions Channel 79 (2.480 GHz)



| Frequency | Level | Limit | Delta |
|-----------|-------|-------|-------|
| MHz       | dBm   | dBm   | dB    |
| 1653.71   | -45.1 | -22.3 | -22.8 |
| 1760.32   | -62.6 | -22.3 | -40.3 |
| 2338.28   | -58.0 | -22.3 | -35.7 |
| 2456.06   | -55.2 | -22.3 | -32.9 |
| 2480.15   | 0.4   | -22.3 | 22.7  |
| 4920.16   | -62.3 | -22.3 | -40.0 |
| 9928.84   | -63.0 | -22.3 | -40.7 |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |
|           |       |       |       |

All levels are with a peak detector unless otherwise indicated.

**Result:** Spurious emissions for low, mid and high channels are below 20 dBc.  
**Conclusion:** Pass

**10 CFR 15.247(f) Power Spectral Density - Hopping Disabled**

The peak power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz bandwidth.

**10.1 CFR 15.247(f) Power Spectral Density - Hopping Disabled Test Setup**

Peak Power Spectral Density measurements were performed at the Apple Computer EMC lab located at 20650 Valley Green Drive. The EUT was placed on a nonmetallic table. The EUT and peripherals were powered from a filtered main supply. Using special test software, the Apple Bluetooth keyboard was set to transmit in single channel mode for each of the low, mid and high channels.

**10.2 CFR 15.247(f) Power Spectral Density - Hopping Disabled Test Procedure**

The frequency spectrum at each of the low, mid and high channels was scanned.

**10.3 CFR 15.247(f) Power Spectral Density - Hopping Disabled Test Equipment**

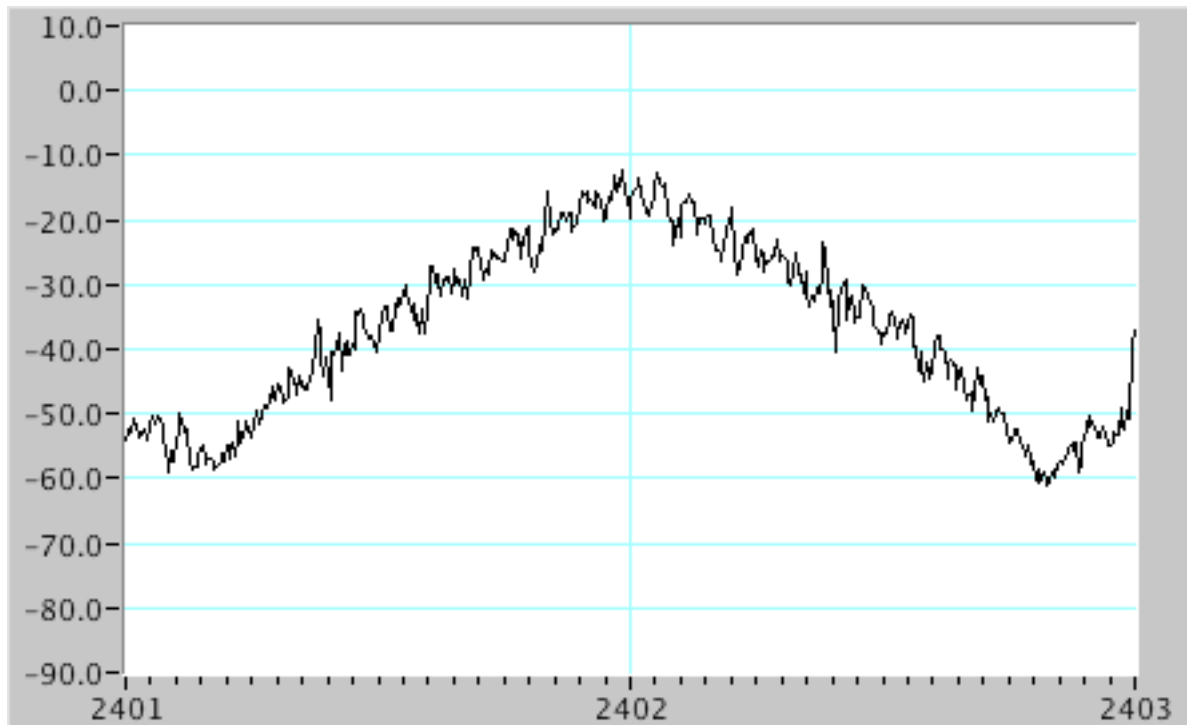
The following test equipment was used when performing power spectral density measurements.

| Description       | Manufacturer | Model No. | Identification No. | Last Cal  | Next Cal  |
|-------------------|--------------|-----------|--------------------|-----------|-----------|
| Spectrum Analyzer | R&S          | ESIB 40   | 100105             | May, 2003 | May, 2004 |

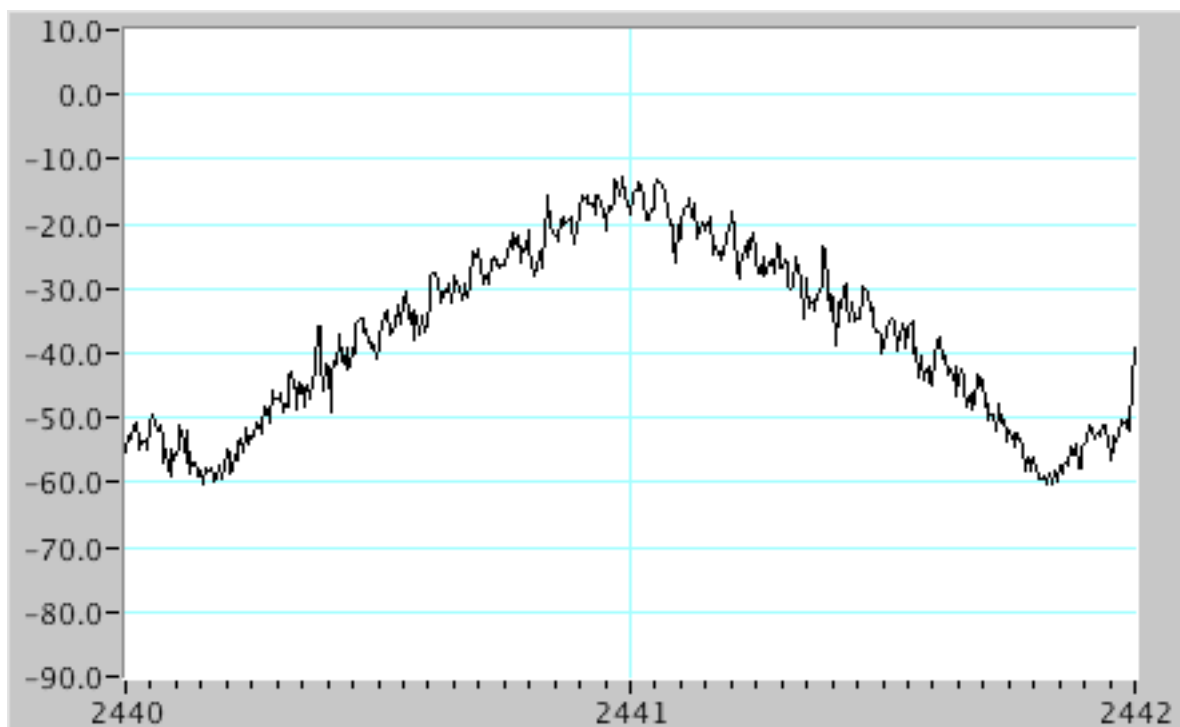
**10.3.1 CFR 15.247(f) Power Spectral Density - Hopping Disabled Instrument Settings**

| Instrument Settings |             |               |          |              |       |
|---------------------|-------------|---------------|----------|--------------|-------|
| Reference Level     | Attenuation | Resolution BW | Video BW | Sweep Rate   | Span  |
| 10 dBm              | 40 dB       | 3 kHz         | 3 kHz    | 560 mSeconds | 2 MHz |

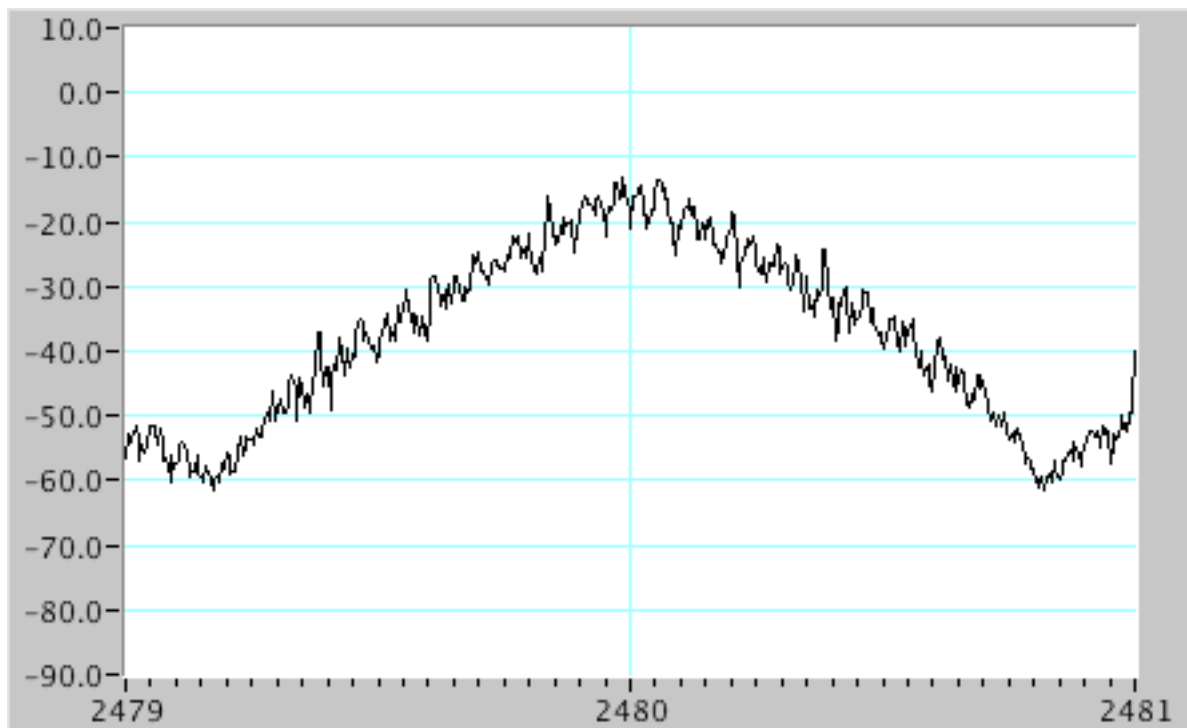
10.4 CFR 15.247(f) Power Spectral Density - Hopping Disabled - Low Channel



10.5 CFR 15.247(f) Power Spectral Density - Hopping Disabled - Mid Channel



10.6 CFR 15.247(f) Power Spectral Density - Hopping Disabled - High Channel



**Result:** The peak power spectral density for low, medium and high channels is less than 8 dBm.  
**Conclusion:** Pass